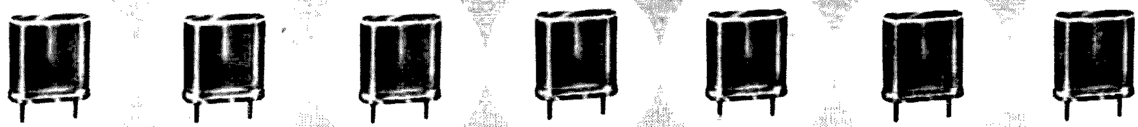
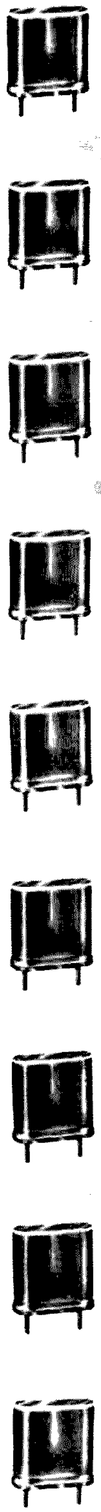
AMATEUR RADIO

73

October 1960

37¢





WHERE TIME AND DEPENDABILITY COUNT IN COMMUNICATIONS . . .

INTERNATIONAL'S *ONE DAY CRYSTAL PROCESSING SERVICE AVAILABLE WORLD WIDE

AMATEURS • EXPERIMENTERS • COMMERCIAL

AMATEUR CRYSTALS (FA-5, FA-9 spot frequencies **1000 KC** to **137 MC .01% Tolerance.**

Wire mounted, plated crystals for use by amateurs and experimenters, where tolerances of .01% are permissible and wide-range temperatures are not encountered.

Designed to operate into a load capacitance of 32 mmf on the fundamental between 1000 KC and 15 MC. Designed to operate anti-resonance on 3rd overtone modes into grid circuit without additional capacitance load. Fifth overtone crystals and seventh overtone crystals are designed to operate at series resonance. (Write for recommended circuits.)

Custom made COMMERCIAL CRYSTALS 70 KC to **100 MC**

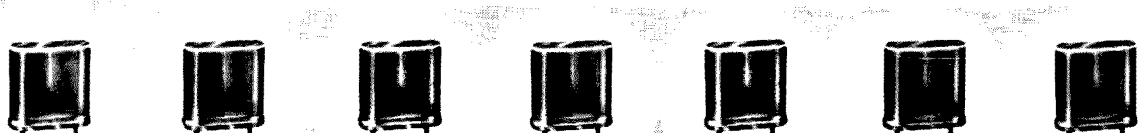
Wire mounted, plated crystals, for use in commercial equipment (Type F-6) where close tolerances must be observed. All units are calibrated for the specific load presented by equipment.

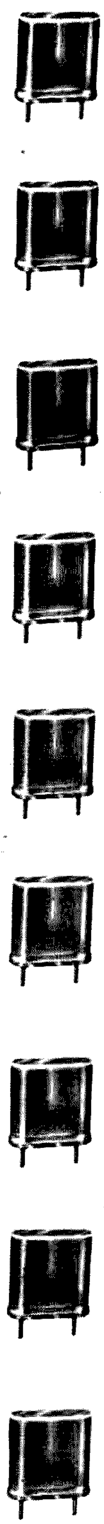
Circuit: As specified by customer. Crystals are available for all major two-way equipment and in most cases the necessary correlation data is on file.

Prices on request.

How To Order: For fastest service, our crystals are sold direct. Terms F.O.B. Oklahoma City.

One Day Processing . . . *Orders for less than five crystals will be processed and shipped in one day. Orders received on Monday through Thursday will be shipped the day following. Orders received on Friday will be shipped the following Monday.*





Now IN ONLY MINUTES CONVERT YOUR CAR RADIO FOR SHORT WAVE RECEPTION WITH A MOBILETTE

International's NEW all transistor, Crystal Controlled Converter.

• Easy to Install. • Works on 6 or 12 volts without change. • Power connector plugs into cigarette lighter socket. (No external power supply needed.)

Designed by International for Amateurs, Citizens Licensees, Short Wave Listeners, Hobbyist.

Available in Seven frequency ranges covering the Amateur bands, 75 through 10 meters, the Citizens band, and WWV National Bureau of Standards Time Broadcasts.

Three simple steps to install (1) Remove antenna lead from car radio and plug into input of Mobilette. (2) Plug jumper wire from Mobilette into antenna connection of car radio. (3) Plug power connector into cigarette lighter socket. Mobilette normally wired for negative ground battery system. When ordering positive ground, add Suffix "P" to catalog number.

International Mobilettes cover these short wave bands.

Catalog No.	Frequency	Catalog No.	Frequency
630 - 105	75 meters (Amateur)	630 - 102	15 meters (Amateur)
630 - 104	40 meters (Amateur)	630 - 101	11 meters (Citizens)
630 - 106	10 MC (WWV Time)	630 - 100	10 meters (Amateur) 28.5 - 29.5 MC
630 - 103	20 meters (Amateur)		

Available soon for 6 and 2 meters at slightly higher price.

INTERNATIONAL CRYSTAL MANUFACTURING CO., INC.

18 NORTH LEE • OKLAHOMA CITY, OKLA.

Complete, ready to plug in and operate . . . . only $19.95

Order direct from International. Terms F. O. B. Okla. City. Include postage. Shipping weight 2 lbs.

Send for FREE Catalog covering International's complete line of Crystals and Equipment.

73 Amateur Radio

1379 East 15th Street
Brooklyn 30, N. Y.

October, 1960
Vol. 1, No. 1

Table of Contents

Staff:

editor-publisher .... Wayne Green W2NSD
production manager .... David Fish
associate editor .... Jim Kyle K5JKX
associate editor .... Don Smith W3UZN
associate editor .... Jim Morrissett W8BAJ/K2OLK
contributing editor .... John Campbell W2ZGU
contributing editor .... Jean Shepherd K2ORS

73 (Title registered U. S. Post Office) is published monthly by Amateur Radio Publishing, Inc. Executive and editorial offices at 1379 East 15th Street, Brooklyn 30, New York. Telephone: INgersoll 9-6957.
Application for entry as second-class matter is pending.
Subscription rates: U. S. A. and possessions, APO, FPO, Canada and Mexico; one year $3.00; two years $5.00; three years $7.00. Foreign: one year $4.00; two years $7.00.

.....de W2NSD

Please understand that this is Volume 1, Number 1 of 73. It is NOT perfect—it isn't even anywhere as good as I'd like it to be. But, all things considered, a major miracle has been worked and this issue IS in print.

Feedback

We both have a vested interest in 73 being as interesting as possible. You can help me keep my finger on your pulse by sending a postcard every month listing the articles in the order of your interest. I will publish results of this monthly survey as an encouragement to the authors. The top author each month will get, in addition to the compliment, a check from us for 50% of his original payment. Thus your vote each month will serve to help me in the selection of future articles and will encourage good writers both with plaudits and some extra cash!

Writing For 73

ONE of the first moves in planning the publication of 73 was to get in touch with past authors of ham articles and explain to them that there was a new magazine coming and that it needed articles. To encourage them we established the firm policy of paying for all articles immediately upon acceptance. This encouraged quite a few, as you can see in this issue, and as you will see in the subsequent issues.

There must be a lot more of you with interesting ideas to communicate. Naturally we prefer technical and construction articles, but if it is interesting and hammy we'll probably shell out. One author has hustled us for over $1000 so far and shows no sign of drying up yet.

Suggested Procedure

If you're in doubt about whether we'll buy or not just send in an outline and, if possible, some pictures. We'll probably OK it. Try to get the best pictures you can and type it up double spaced (use a dictionary).

Laboratories Needed

Readers and manufacturers both expect us to run the same old tests on new equipment and write up pleasant little blurbs which carefully sidestep the obvious shortcomings of the gear and repeat almost verbatim the specifications published in the ads. I have tried running honest reports on equipment in the past only to meet mountains of emotion from the manufacturers and their advertising agencies and apathy from the readers. This was obviously not the correct approach.

After much stewing over this problem I think I have an answer that will satisfy everyone . . . even me. Unfortunately, even with the twenty-four year collection of radio debris around the shack I don't have the necessary equipment to do the job of testing that I have in mind. And any of you chaps with an inclination to do something helpful for us all suitably equipped? You'd need a pretty good 'scope, dummy loads for various power levels, an rf voltmeter, an ac ammeter, a KW Variac for line voltage tests, an audio oscillator, frequency meter, antenna tuner, etc. This would enable you to run fairly good checks on a transmitter. The receiver tester would have to have different gear.

What I want is a thorough technical listing of the facts about the equipment. For a transmitter we want to know the list price, weight, size, tubes used, bands covered, ac power on standby, ac power under full load, heating under full load, input to final, output power, efficiency, frequency stability during transmit, drift during standby, antenna switching provisions, compatibility with other commercial gear, how well fused, how well the operator is protected from electrocution, ease of servicing, TVI, ease of tuning, ease of bandchanging, calibration of VFO (if any), resetability of VFO, backlash of VFO dial, spotting switch, high voltage on standby, high voltage under full load, interlocked, overload relay or protection, 108 volt test, 132 volt line test, audio response, shipping weight, connecting wires supplied, driving power required (amplifiers) on various bands, etc.

Then comes the objective on-the-air activity with the rig for a couple of weeks to get the feel of it. By this time the writer should be able to turn out quite a piece, listing the statistics and pointing up the more positive aspects of the equipment in a general commentary.

We need the same treatment for receivers and other ham items. Anybody interested? The pay is miserable. All those who do not volunteer take one step backwards.

Our Advertisers

It takes a lot of personal interest in the hobby for an advertiser to run an ad in a brand new ham magazine. He has to put aside questions about what this will cost him in dollars per thousand readers and how much duplication he is getting of readership in other ham magazines. He already has his budget allocated for a long time ahead and this means an extra unexpected expense which may well bring little return.

Since it is advertising revenues that make it possible for magazines to be published we all owe a lot of gratitude to the handful of

(Continued on page 25)

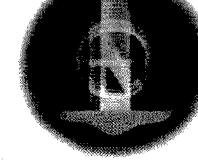
from EICO® . . a completely new

CITIZENS BAND TRANSCEIVER

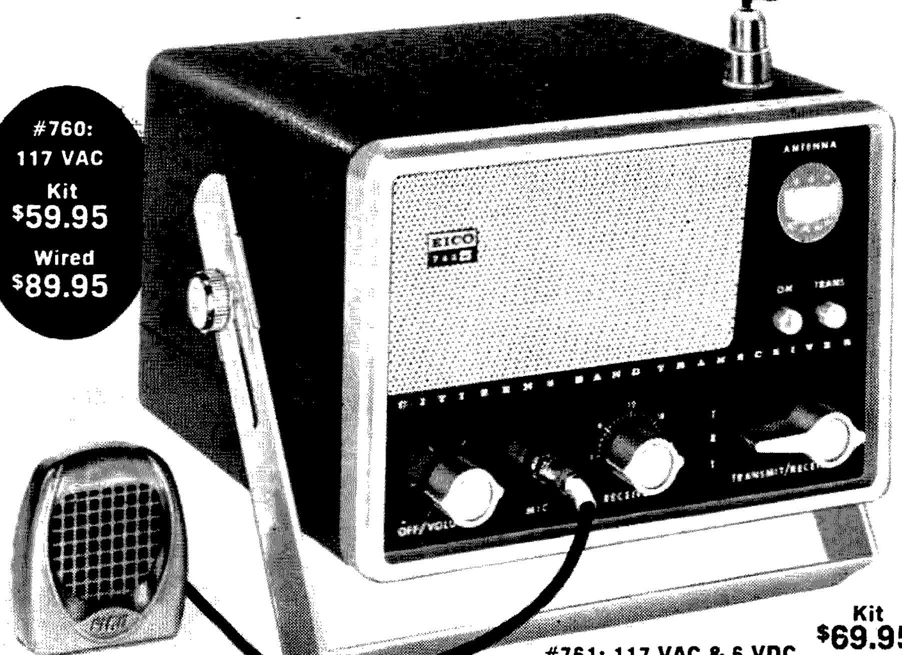
that meets FCC regulations*

***EICO premounts, prewires, pretunes, and seals the ENTIRE transmitter oscillator circuit to conform with FCC regulations (Section 19.71 subdivision d). EICO thus gives you the transceiver in kit form that you can build and put on the air without the supervision of a Commercial Radio-Telephone Licensee!**

designed by Hams . . . for Hams . . .



to the highest Ham standards



#760: 117 VAC
Kit $59.95
Wired $89.95

#761: 117 VAC & 6 VDC
#762: 117 VAC & 12 VDC
incl. mtg. bracket (Pat. Pend.)

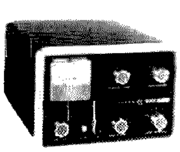
Kit $69.95
Wired $99.95

Highly sensitive, selective SUPERHET (**not** regenerative) receiver with 5½ dual function tubes and RF stage. Continuous tuning over **all** 23 bands. Exclusive **Super-Hush**® noise limiter. AVC. 3"x5" PM speaker. Detachable ceramic mike. 5 Watt xtal-controlled transmitter. Variable "pi" network matches most popular antennas. 12-position **Posi-Lock**® mounting bracket. 7 tubes and 1 xtal (extra xtals available). Covers up to 20 miles. License available to any citizen over 18 — no exams or special skills required; application form supplied free.

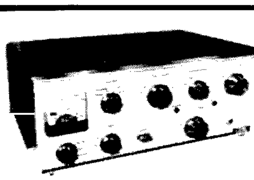
Antennas optional.

Additional crystals $3.95 each.

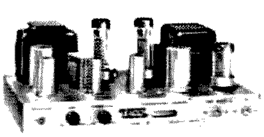
Most EICO distributors offer budget terms.



NEW! 60-WATT CW TRANSMITTER #723
Kit **$49.95** Wired **$79.95**
Ideal for novice or advanced ham needing low-power, stand-by rig. 60W CW, 50W external plate modulation. 80 through 10 meters.

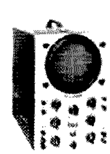


90-WATT CW TRANSMITTER*
#720 Kit **$79.95** Wired **$119.95**
*U. S. Pat. No. D-184,776
"Top quality" — ELECTRONIC KITS GUIDE. Ideal for veteran or novice. 90W CW, 65W external plate modulation. 80 through 10 meters.



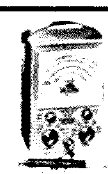
HIGH-LEVEL UNIVERSAL MODULATOR-DRIVER #730
Kit **$49.95** Wired **$79.95**
Delivers 50W undistorted audio. Modulates transmitters having RF inputs up to 100W. Unique over-modulation indicator. Cover E-5 $4.50.

GRID DIP METER #710
Kit **$29.95** Wired **$49.95**
Includes complete set of coils for full band coverage. Continuous coverage 400 kc to 250 mc. 500 ua meter.



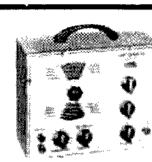
COLOR & MONO DC-5MC LAB & TV 5" OSCILLOSCOPE #460
Kit **$79.95** Wired **$129.50**

5" PUSH-PULL OSCILLOSCOPE #425 Kit **$44.95** Wired **$79.95**



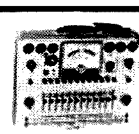
PEAK-TO-PEAK VTVM #232
Kit **$29.95** Wired **$49.95**

VACUUM TUBE VOLTMETER #221
Kit **$25.95** Wired **$39.95**



RF SIGNAL GENERATOR #324 (150kc-435mc)
Kit **$26.95** Wired **$39.95**

TV-FM SWEEP GENERATOR & MARKER #368
Kit **$69.95** Wired **$119.95**



DYNAMIC CONDUCTANCE TUBE & TRANSISTOR TESTER #666
Kit **$69.95** Wired **$109.95**

TUBE TESTER #625
Kit **$34.95** Wired **$49.95**

EICO®
33-00 Northern Blvd., Long Island City 1, N. Y.

EICO, 33-00 N. Blvd., L.I.C. 1, N.Y. 73-10
Show me how to save 50% on 72 models of top-quality: ☐ Ham Gear ☐ Test Instruments ☐ Hi-Fi ☐ Send free Short Course for Novice License. Send free catalog and name of neighborhood EICO distributor.

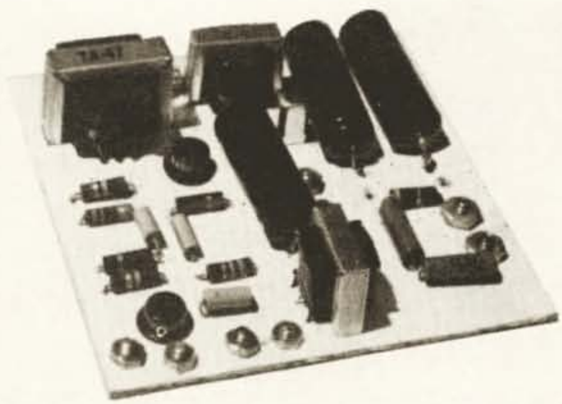
Name ....

Address ....

City .... Zone .... State ....

Add 5% in the West.

The Audio Booster



Jim Kyle, K5JKX/6
11953 Cameo Place
Granada Hills, Calif

How would you like to have 100 percent modulation at all times, instead of just on peaks?

Here's a gadget that hangs between your mike plug and the transmitter input that can do just that for you[1]. It's based on an unusual telephone-repeater circuit developed for use on a 26-mile intercom line. Addition of a gain-controlling channel produced The Audio Booster.

The original circuit was unique in that it amplified signals passing in either direction over the line, and had only one set of terminals which doubled as input and output. This feature has been retained, in case your rig puts an audio signal back into the microphone.

The quickest way to analyze circuit operation is to take a look at the block diagram, Fig. 1, and the input-bridge simplified schematic, Fig. 2, while reading the following paragraphs.

Looking at Fig. 1, you'll see that a signa coming from the microphone passes througl the input-bridge to the input sides of both amplifiers. Amplifier No. 1 boosts the signal some 40 db, then rectifies it to produce a positive control voltage. This control voltage is appliec to Amplifier No. 2 to adjust its gain. With a strong signal, representing an audio peak, the gain of Amplifier No. 2 can be reduced to zero With a weak signal, however, Amplifier No 2 can produce some 50 db gain.

The amplified output from No. 2 is returnec to the input-bridge circuit, from which it goes on to the transmitter. You can see that a strong signal, or peak, will not be affected by the presence of the Booster. Weaker signals or "valleys", though, will receive some 40 db of boost. Since the dynamic range of your microphone's output is probably only about 20 to 25 db, this means that you have the ability to turn speech "inside out" amplitude-wise, if you like. By adjustment of the limiting threshold control in the AGC line, however, you can keep the signal right side up while reducing the dynamic range to only 3 or 4 db if you like.

[1]You don't really want to adjust it that way, though. It would wipe out all amplitude variation, leaving only the frequency components to carry your voice, and the result is completely unintelligible!

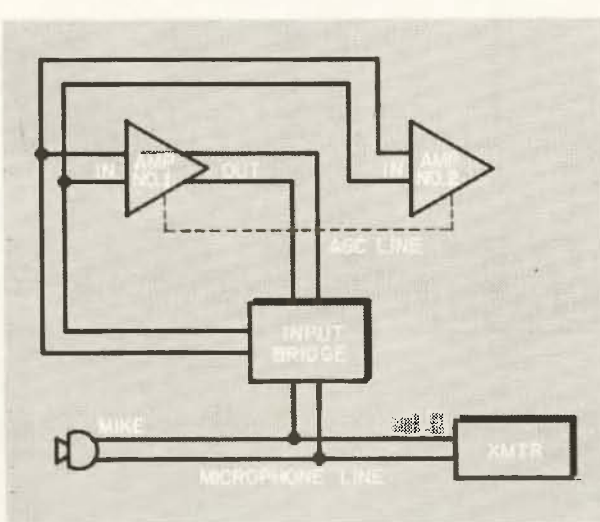


Fig. 1. Block diagram of the Audio Booster and its tie-in to your audio system. Operation is explained in the text.

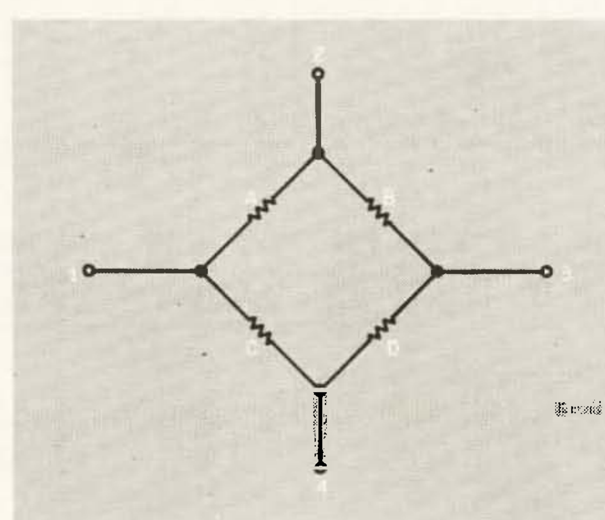
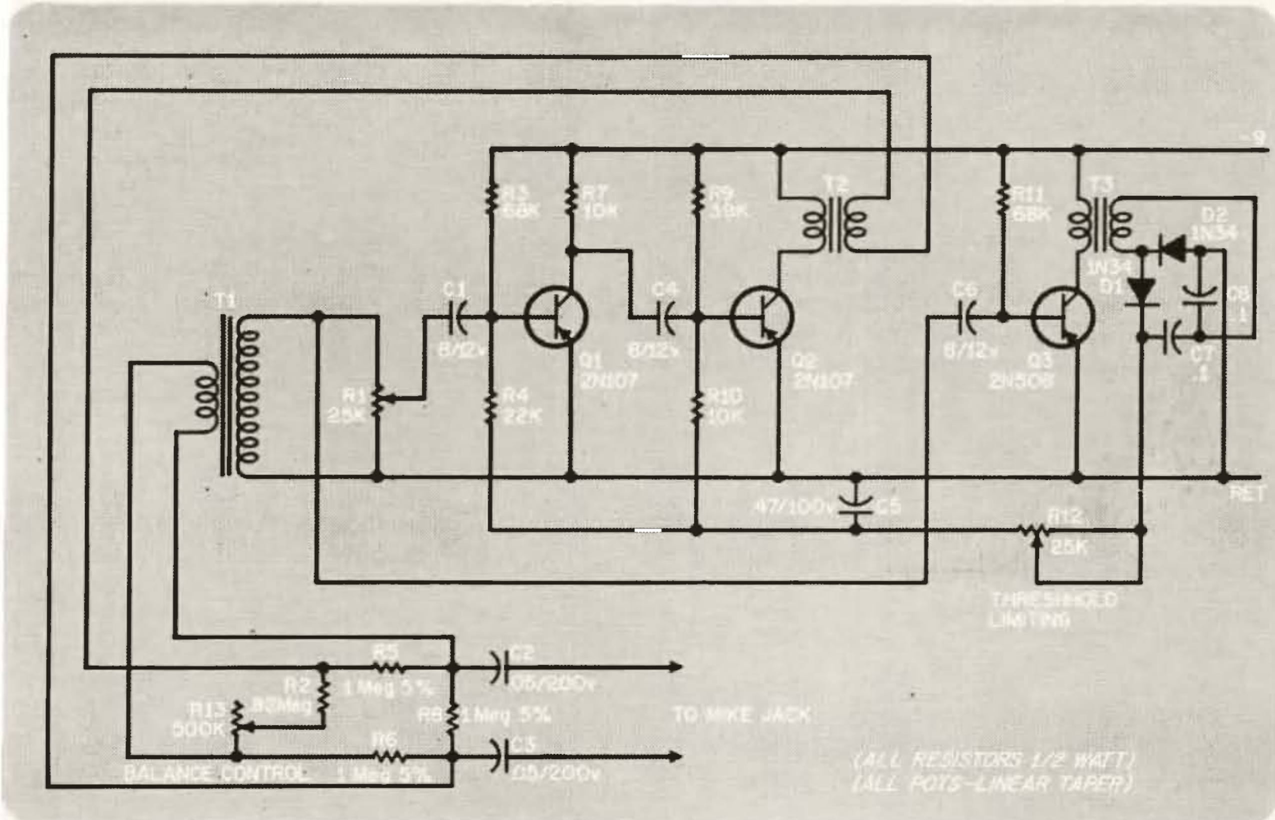


Fig. 2. Input-bridge circuit, simplified schematic diagram. If all resistance are equal, the bridge is balanced.



PARTS LIST

Transformers:

T1— Transistor input transformer, primary impedance .2 meg, secondary impedance 1 K (Stancor TA-47 with primary and secondary connections reversed, or equivalent)

T2— Transistor interstage transformer, primary impedance 10 K, secondary impedance .16 meg (Stancor TA-32 or equivalent)

T3— Transistor interstage transformer, primary impedance 10 K, secondary impedance 200 ohms (Stancor TA-34 or equivalent)

The input-bridge circuit is the feature borrowed from the airfield intercom design. Fig. 2 will probably look familiar to you as a Wheatstone bridge. The bridge, when balanced, produces infinite isolation between terminals 1 and 3 and terminals 2 and 4, and vice versa. However, if a signal is coupled across arm A only, it will show up at both sets of terminals. Conversely, a signal fed in at either pair of terminals will show up in arm A.

Therefore, arm A can be connected across an audio line, and any signal appearing on the line will show up at all four terminals of the bridge. Let's hook 1 and 3 up to the input of an amplifier, and 2 and 4 to the output[2]. Now, any signal coming in on the line will go to the amplifier input. After it has been amplified, it will come back in to the opposite and isolated bridge terminals, and be returned to the line from whence it came. Still, input and output of the amplifier are isolated and oscillation will not develop.

Theoretically, there's no limit to the amplification you can obtain with one of these. In practice, about 40 db. is the limit, since that's approaching the limit of isolation in a practical bridge circuit. If the line is non-reactive, and if you provide a fine balance adjustment (R13 in Fig. 3) and take care in construction to minimize stray coupling, a few more decibels may be squeezed out.

The only thing to watch out for in construction of the Booster is stray coupling around the bridge. This may limit your usable gain and consequently the compression ratio of the gadget. Otherwise, construction is according to usual transistor practices. An LMB No. 143 box chassis provides plenty of room for components. Locking-type potentiometers are recommended, but they're expensive. H. H. Smith lock nuts for standard volume controls work just as well.

To put the booster in operation, first hook it across the input of an amplifier connected to a speaker. R1, the floor level control, should be at minimum setting and the AGC line should be temporarily grounded to remove all control voltage from the boosting amplifier (connect a jumper from the base end of R12 to the return line).

Slowly advance R1 toward maximum. At some point, unless you're lucky and have per-

(Continued on page 46)

[2]Notice that both input and output of the amplifier must be isolated from ground. This means that transformer coupling is a must when using this circuit.

Something New in Frequency Modulation

R. E. Baird, W7CSD
Oregon Technical Institute

THE production of a new and strange kind of variable capacitor recently came to the attention of the writer. This capacitor takes the form of a semiconductor, is about the size of a germanium diode, and is available in sizes from 7 to 100 mmfd. The strange thing about this little gadget is that the capacity is a function of a dc bias voltage impressed across it. The manufacturer, Pacific Semiconductors Inc., Culver City, California, use a standard voltage of four volts as the 100% capacity rating point. It may be seen from the curve in Fig. 1 that at zero voltage the capacity is about 250% and at 100 volts the capacity has dropped to 20% of the 4 volt value. *Caution*: A reverse polarity voltage should never be used and any superimposed ac peak must not go on the other side of zero.

As soon as you get the full import of the above you begin to get ideas. The "Varicap," for such is its trade name, has many possibilities. The first one the writer thought of was an FM modulator.

The Modulator

It is fairly obvious that the Varicap as part of the frequency determining circuit in a self excited oscillator would vary the frequency in accord with its bias voltage. It was decided to use the Varicap in conjunction with a Meissner Signal Shifter to achieve FM. A close check with an oscilloscope revealed that the peak voltage across the frequency determining grid tank of the oscillator might run as high as 20 volts. Since a bias voltage in excess of 20 volts is not in the portion of the curve most usable for this purpose, it was decided that a 5 mmfd ceramic would be put in series with the 50 (approx) mmfd Varicap across the tank as shown in Fig. 2. This gives a voltage division leaving less than 2 volts rf across the Varicap which can be biased with 3 or 4 volts dc.

The modulator was constructed as shown in the illustrations and connected across the grid tuning condenser in the Signal Shifter with

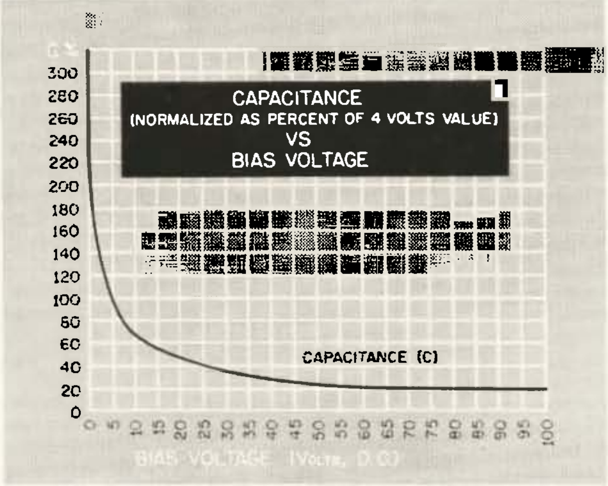
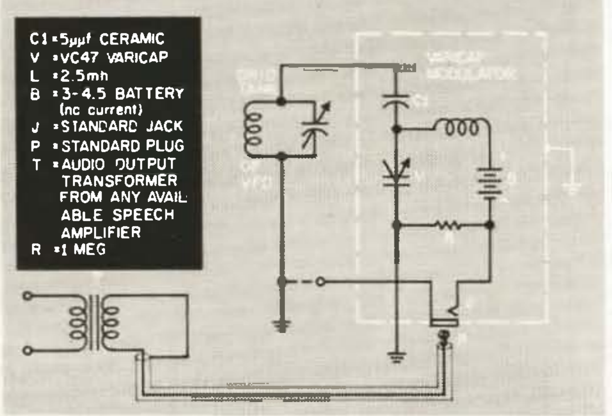


Fig. 1

Courtesy of Pacific Semiconductors, Inc., 10451 West Jefferson Boulevard, Culver City, California

Fig. 2



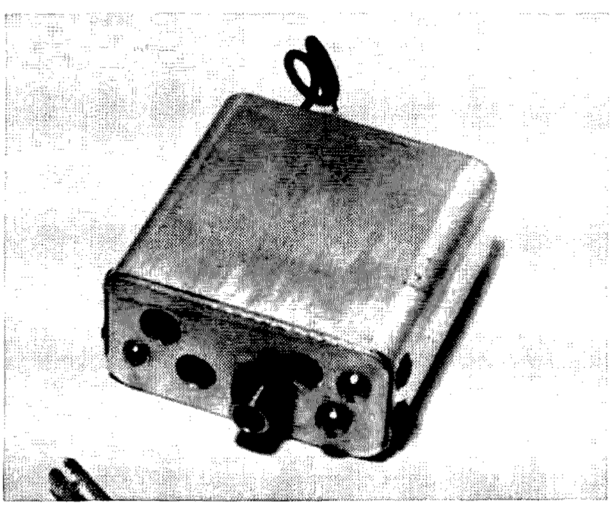
audio input jack in the side of the cabinet. Tests indicated rather high quality speech, even using slope detection. In the shifter shown the oscillator frequency is 10.5 mc and output is on 21 mc. This in turn feeds a 400 watt power amplifier.

Side bands

For amateur use NFM has been defined as FM which takes up the same band width as conventional AM. The Varicap offers an unusual possibility in that the size of one side band may be greatly reduced. If the Varicap is biased at the knee of the curve, approximately four volts, a reduction of 2 volts will raise the capacity 50% while an increase of 2 volts will decrease the capacity only about 10%. With an ac signal it will be seen that the lower side band will be much wider than the upper side band; in fact, the upper side band almost disappears. You might say we have single side band FM, with carrier. If the bias is reduced to less than 3 volts, side bands approach the same size.

Quantitative Tests

The writer had never used FM in ham radio before, so it seemed that some tests as to its effectiveness were in order.



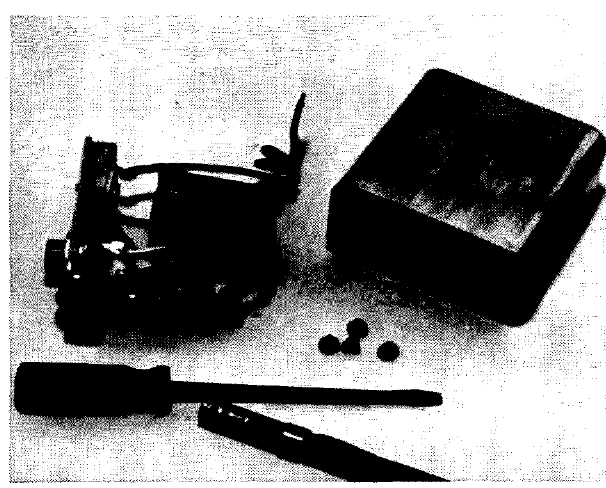
Using a dummy antenna and tone modulation the transmitter was adjusted for 100% AM. An HQ-160 located about 100 yards distant was then adjusted so that the audio output indicated by a VTVM was 1 volt, when tuned for maximum signal. Without changing any volume control on the HQ-160, the AM was removed, and FM substituted. Tuned for maximum slope detection the audio measured .9 volts. The side band was observed to be 3 kc wide. This is certainly a pretty good argument for FM. For the CW man wanting to go on phone the economy would be hard to beat.

It just so happened that the power amplifier used was a pair of suppressor grid modulated 4E27A tubes. As such, in order to get 100% AM it is necessary to run at a high negative voltage on the suppressors and very inefficient carrier conditions. A second test was run with the suppressor grids grounded. This of course doubled the input and the efficiency giving about four times as much carrier power (with the tubes running cooler). The measured audio voltage at the output of the HQ-160 was exactly 2 volts. So it would seem that the FM has an efficiency modulated AM system beat by a ratio of 2 to 1. This assumes, of course, that the power supply can deliver the extra power. If such is the case the amplifier will put out twice as much talk power on FM as it will on efficiency modulated AM.

On the Air Tests

On the air tests have left nothing but satisfaction. Reports continually are received "I wouldn't have known it was FM if you hadn't told me." Comparison of AM and FM same carrier level have been just about a dead heat and with the power upped, as indicated above, the FM is way ahead.

One very peculiar report which has left the writer puzzled is that many hams who have received other FM signals say that FM by this method is much cleaner and easier to copy.



You would think that FM is FM no matter how you get it, but such seems not to be the case. Possibly the curve presented by the rate of change of capacity better complements the selectivity curve of most receivers than does reactance tube modulation or some other method. Discriminator detection has been reported as excellent.

The Varicap makes a first class FM modulator embodying simplicity itself. The reader might be interested to know that a high impedance mike driving a single transistor will operate the Varicap modulator. A kilowatt transmitter with one transistor as the only stage of audio is a little unusual to say the least. We will perhaps see many other uses for the Varicap in the future. 73

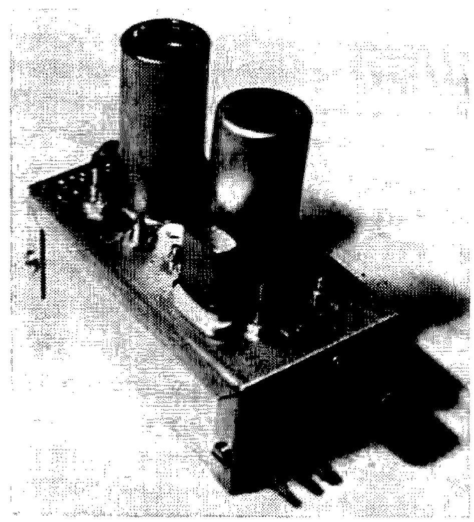
IN the past few years, since the VHF operations took deep roots, many manufacturers, together with some of the braver amateurs embarked on a rather new idea of building and marketing converters for most frequencies in the amateur spectrum. Each one claimed better performance, more gadgets and a lower price. Some of the manufacturers incorporated expensive tubes, others used common tubes with tricky dolled up circuits claiming ridiculously low noise figure that could only be achieved by parametric amplifiers or tunnel diodes.

The consensus of opinion among many brethen is that the more tubes and gadgets that are splattered in the circuit, the better the performance. Nothing is farther from the truth in the majority of cases. Of course there are circuits with desirable gadgets that can be found in many good converters whose specs

sibilities of using a common drug-store variety of tubes to do a man size job in the VHF region. Making a page by page search in the tube manuals for data and curves on various inexpensive tubes, the 6U8 offered favorable answers and was given the acid test by building a 144 mc converter around them. Several circuits and components lay-outs were tried and evaluated in the frequency range of 50 mc to 220 mc and working models built. Upon completion of these models and optimizing of their circuits, reduction of components and miniaturization was undertaken for simplicity, space saving and reduction in cost. As you will notice, there are no superfluous gimmicks, rf chokes or expensive feed-thru capacitors that are almost universally used in commercial gear. These items were completely ignored by proper parts lay-out and point to point wiring that is clean and straight forward.

Bantam Converters

John Wonsowicz, W9DUT
4227 N. Oriole Avenue
Norridge 34, Illinois



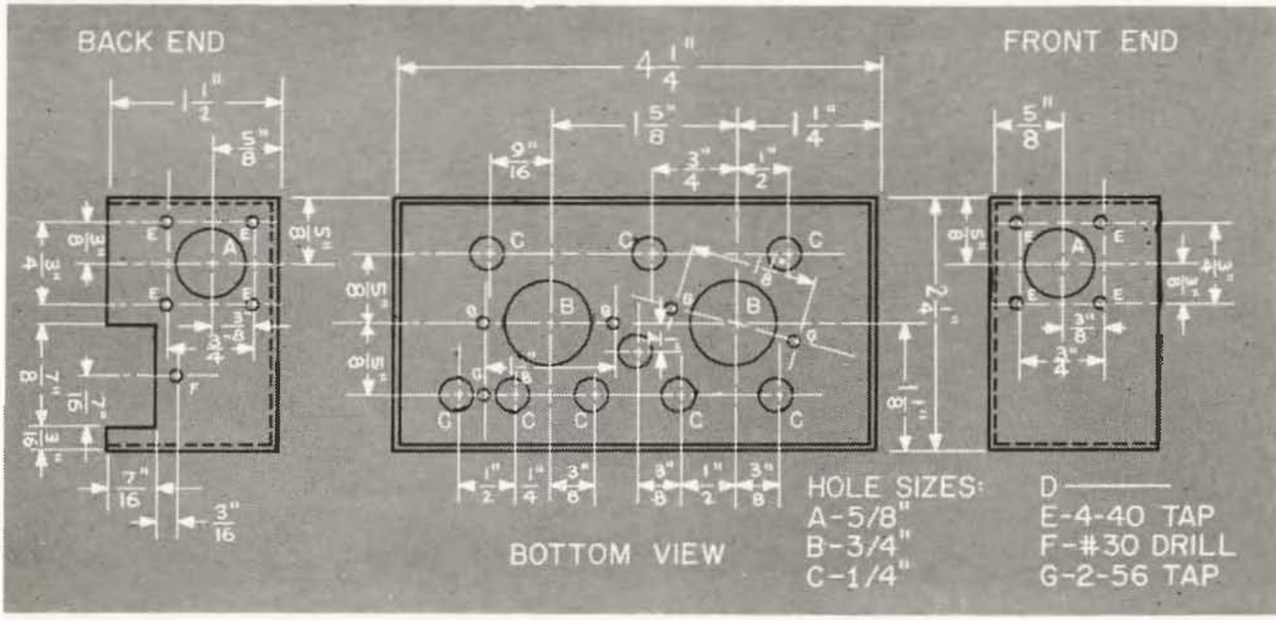
can be checked and found as advertised. But there are many on the market that do not meet the advertised claims although they possess the same number of components or perhaps even more gadgets. Now, how is one to know without first buying and suffering with the unit until something better, or at least different, comes along for another bitter experience? That type of operation is not too bad for those that can easily afford it, but how about the ham with a limited budget and a burning desire to own something good the first time?

This article was written especially for those who want the most for their dollar and personal satisfaction in constructing a fine unit capable of maximum performance with the minimum of components. The simple bantam converters herewith described, we sparked about two years ago while exploring the pos-

Lay-out

The mechanical lay-out of all converters except the 220 mc are identical, and a typical chassis lay-out will serve them all. Coil forms are ⅜" O.D. C.T.C. slug tuned and all bias resistors and isolation resistors are typical. However, the by-pass capacitors and coupling capacitors are chosen for optimum performance at the operating frequencies and these are indicated in the parts list.

In laying out the mini-box chassis care must be exercised not to deviate from dimensions given for they are important in so far as proper coupling between coils and good shielding between input and output circuits is concerned. The mini-box chassis is a Bud product, No. CU-3016 (4¼ x 2¼ x 1½) natural finish aluminum. The shield, as seen in the photo, is 1/32" brass plate shaped and cut



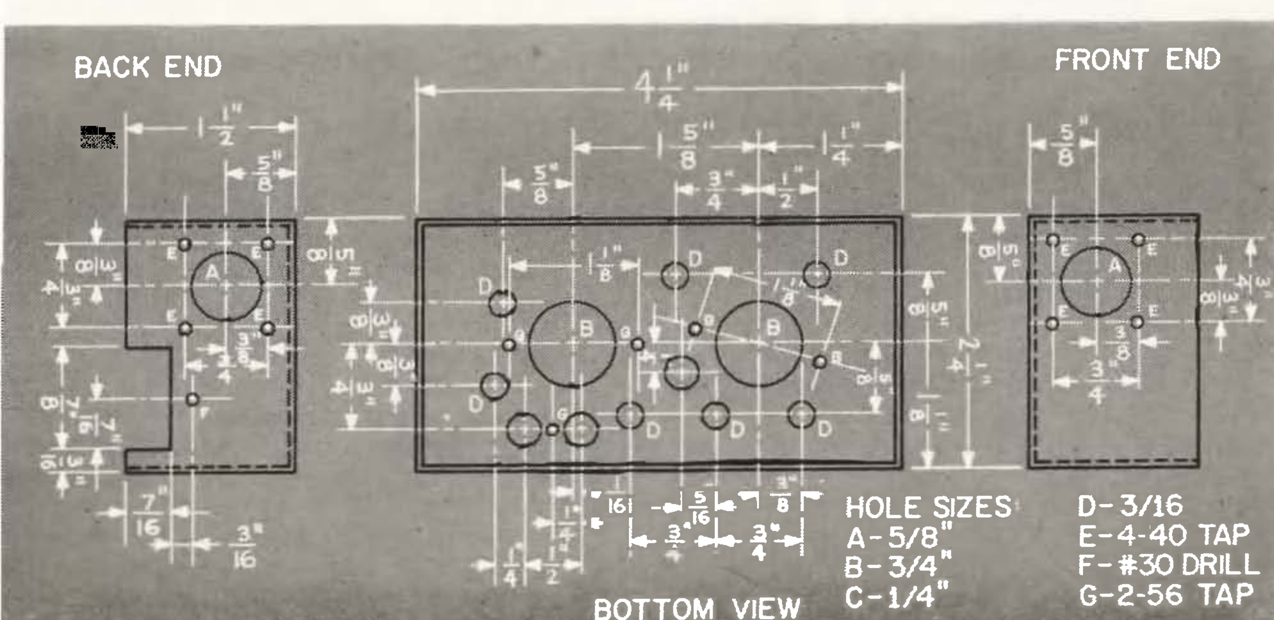
ut for the tube socket and mounted as shown n the drawing. It is held in place by two -56 screws and soldered to the center of the ube socket. This also serves as a low re-istance ground plate to which all components eturning to ground are soldered.

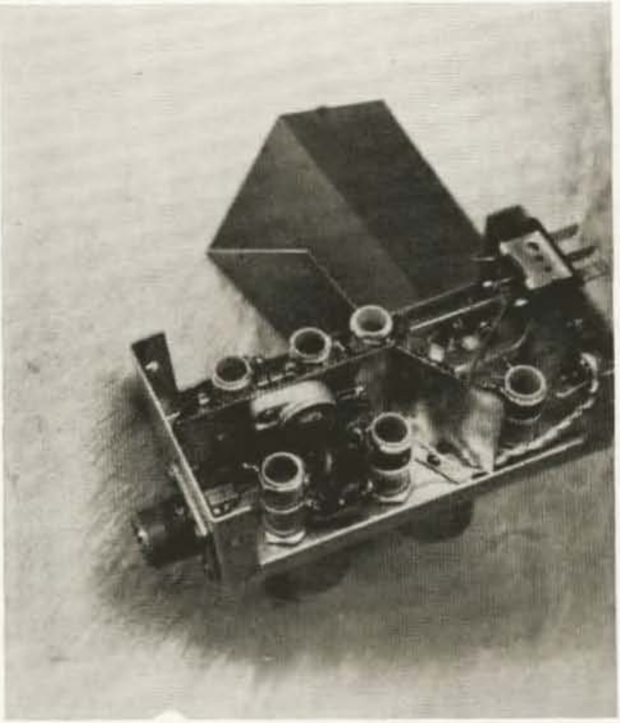
The mechanical difference in the 220 mc onverter is the addition of another 3/16" ıole for an extra coil and slight juggling f other parts to fit the same type of chassis. 'his can be seen in the full size drawings.

Circuits

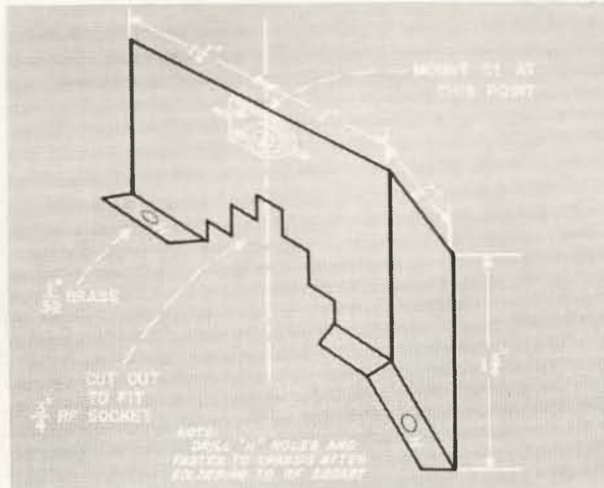
In describing the circuits lets start with he highest frequency converter first, the 220 ıc unit. In this converter, as in all others, he first tube, a 6U8, performs two functions. The triode section is used as a low noise grounded grid amplifier and the pentode section is used as a mixer. The signal is fed through the variable capacitor C1 to a tap on the cathode coil L1 which is slug tuned, and the amplified signal at the plate of L2 is inductively coupled by the close proximity of the coils to the grid of the mixer. The grid is coupled to the coil by 13 mmf capacitor and a test point separated by two 470K resistors is provided for measuring oscillator injection, as will be explained in "testing". The plate of the mixer is tuned to 13 mc the if frequency and the output is link coupled for low impedance output to the receiver. Incidentally, this 13 mc if coil is ⅜" od C.T.C., the same size form as in all other converters.

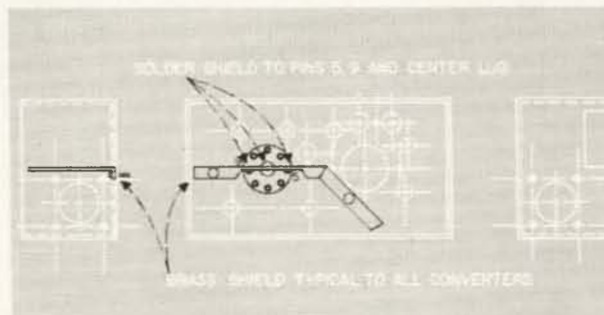
The second 6U8 is a generator that provides





SHIELD DETAILS





three functions in one envelope; oscillator, tripler and doubler. The grid of the pentode section and its screen is used as a third overtone crystal oscillator. The screen is tuned to slightly higher than the crystal frequency of 34.5 mc. The signal appearing at the screen has a harmonic content strong enough so that the plate circuit can pick off the third harmonics and is tuned to 103.5 mc. This output is then capacitively coupled to the grid of the triode section and the plate of this triode is tuned to the second harmonic making it resonant at 207 mc. This signal, beating with the incoming signal of 220 mc produces an if frequency of 13 mc. Since the receiver tunes from 13 to 18 mc a coverage of 220 to 225 mc is achieved.

The 108, 144, and 152 mc converters use ⅜" od coil forms in all circuits and the first 6U8 performs the same function as in the 220 mc unit. However, the second 6U8 differs in that it is used as an oscillator in the triode section and a tripler in the pentode section, as shown in the schematic.

The 50 mc and lower frequency converters differ from the above by isolation of the crystal oscillator only. The triode section is used as the straight through crystal oscillator operating on the crystal fundamental frequency, and the pentode section is tuned to the oscillator frequency and controlled by adjusting the core in the output coil L5 for proper injection voltage to the mixer, by slightly detuning it. For best signal-to-noise ratio and best sensitivity of all these converters it was found that injection voltage of .6 to .8 volts at the test point measured with a Simpson Model 260 Volt-Ohmmeter was optimum. Higher or lower injection brought higher noise or lower sensitivity.

Although the author has built converters below 50 mc, the coil data is not given since most commercial receivers tune up to 30 mc. However, those interested in constructing converters below this range should use a grid dipper for resonating the coils and pick out the size and type of coils as a starter from the coil chart given under the heading of Res. Freq.

Construction

The construction of these converters is quite simple and components are inexpensive. However, proper sequence of parts placement is important for ease of assembly. Bear in mind that all components except the coils are placed and soldered in their respective positions; then make up the coils for the desired band, secure them to the chassis and solder in the necessary parts to the coils.

Step one. After the chassis has been layed out and drilled, fasten in the two sockets orienting them as shown. Next fasten in the brass shield soldering it to the center lug and pins 5 and 9 of the rf socket.

Step two. Fasten the antenna, if output and power connectors into place as shown in the photo and make the necessary connections to them.

Step three. Solder in the resistors and capacitors.

Step four. Secure and solder in the coils. 'his sequence proved to be best for the many onverters that have been built and eliminated he scorching of components with the soldering ron or leaving cold solder joints in hard to :et at places.

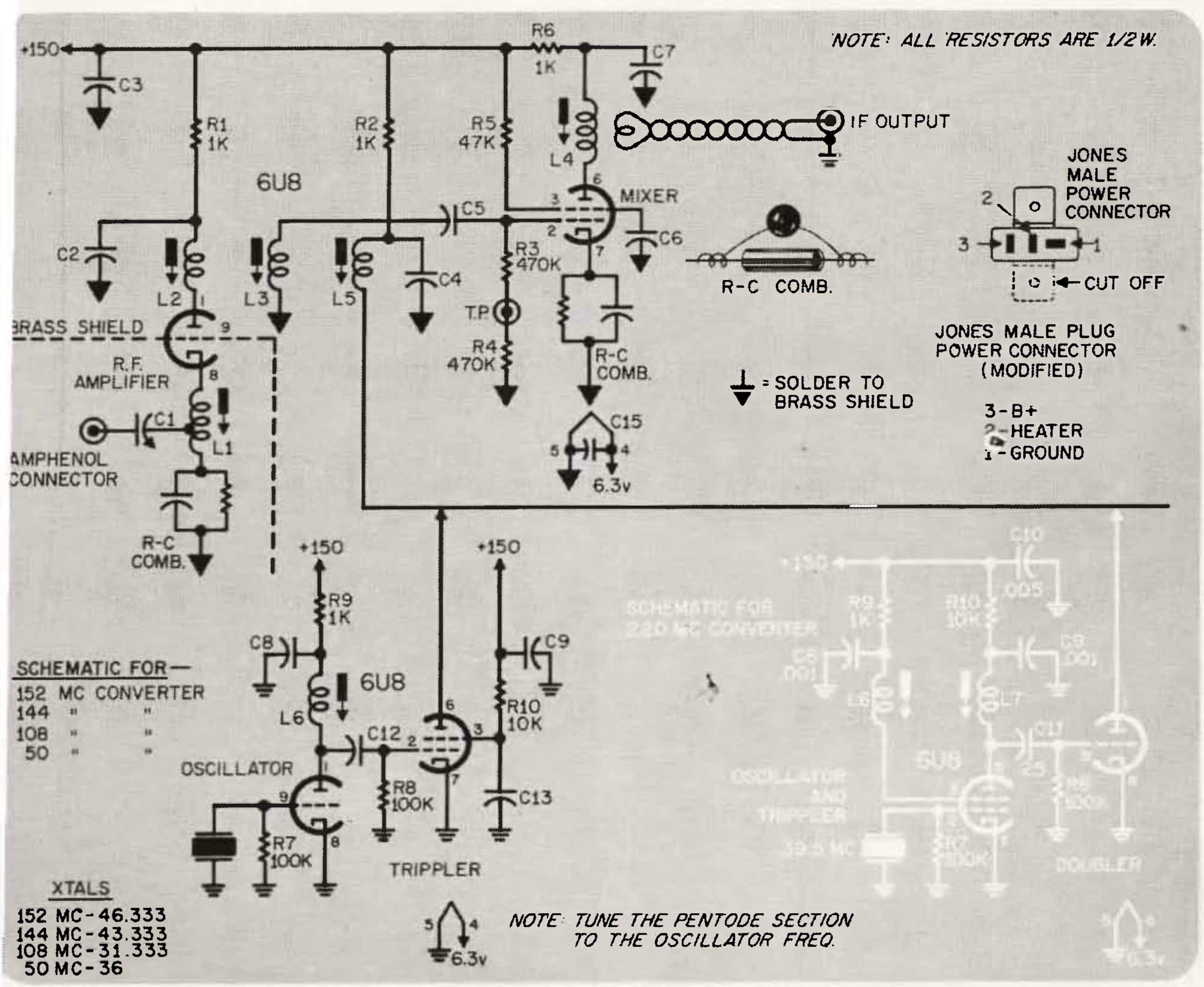
Tuning

Tuning of all converters is rather typical; ınly slight deviations may be necessary on ome frequencies, and these will be apparent o the builder.

Let's start tuning the most popular one, the 44 mc converter. If a grid dipper is handy, he entire unit can be closely tuned and then ›eaked on the air. However, to optimize the ›erformance, a noise generator should be ısed. Assuming that neither is on hand let's ›tart by setting the cores in all coils about half vay; next, insert the negative lead of your Volt-Ohmmeter into the test jack and the positive lead to chassis. Set the Volt-meter to its owest dc range. Connect the antenna to the nput and if output to your receiver tuned to 14 mc. Apply power to the converter; 150 volts B+ and notice if your receiver S-meter kicks up with additional noise. If not, the oscillator is not working and the osc. core should be adjusted to slightly higher frequency. While adjusting this core observe the S-meter for a slight swing or listen to your speaker for an increase in noise, then leave the core set at this position. If the oscillator kicks out a good signal the voltmeter at the test point will also indicate a slight reading. Now, observing the voltmeter, tune the tripler coil L5 for the highest reading. Next, tune in a signal on your receiver and peak the rest of the coils for the loudest signal. After all coils are tuned, return to the tripler coil L5 and adjust the injection voltage for .6 to .8 volts. At this point the signal appears cleanest. During this adjustment it may be necessary to slightly touch up on the mixer grid coil L3. After this is done and the signal is tuned in, try playing with the cathode coil L1 and the series antenna capacitor C1, juggling them for the best signal-to-noise ratio.

In the 220 mc converter the tripler coil L7 should be peaked for the highest indication on the meter and left alone. Then juggle for injection voltage between the doubler coil L5,

(Continued on page 46)



The Risky Hobby of Hamming

SOME folks think that hams are the world's worst athletes, but the truth is that amateur radio has put the daring young man on the flying trapeze in second place. The cause for the confusion may be that magazines usually picture a ham reclining in a plush swivel chair surveying a table full of gear, not giving the slightest hint that there is more to the game than meets the eye. How is the casual reader to know that the limp-looking guy in the photograph spent half the day wrapped around the weaving top of a 100-foot tower juggling a handful of tools and a fifteen pound rotator in a gale wind? As a general rule, it's safe to say that for every set of call letters heard on the bands, somebody huffed and puffed to tie a long wire or install a beam antenna.

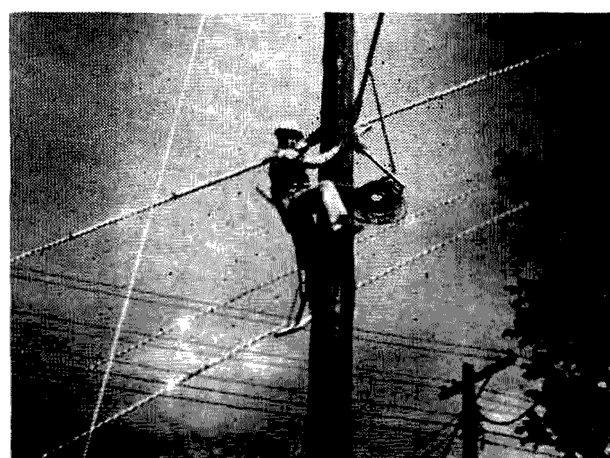
"My XYL worries about extra pounds," says one limber fellow, "but all I have to do to stay trim is run up and down my tower a couple times a day."

Hams can still buy life insurance, but there are certainly lots less hazardous hobbies. The wildest game of tiddly-winks results in nothing worse than a sore tiddling finger, but anybody

←Worried about a few extra pounds? K9AMD advocates tower-climbing for loss of weight.

Part I of a 3-part Story:

W9EHH, Mike Hrindak, of Gary, Indiana, is "up a tree." With a beam antenna, lead-in, and tools, he's wondering "What'll I do now?" ↓



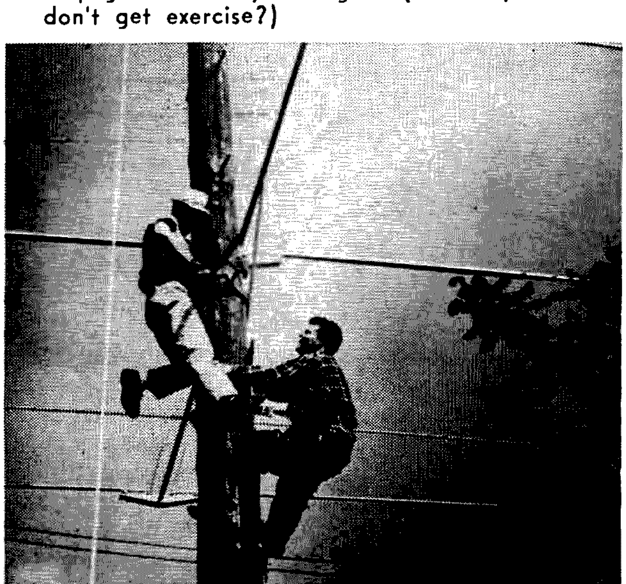
Carole F. Hoover K9AMD
401 East Wood Street
Hillsboro, Illinois

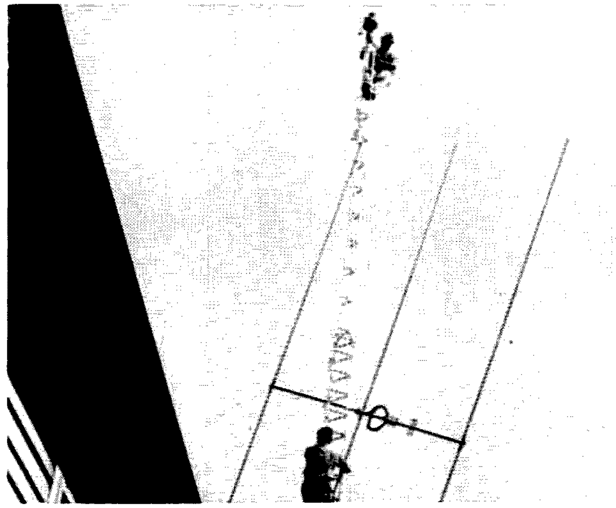
who takes an unchartered flight from a sloping roof or slippery pole may end up in enough plaster casts for an army to autograph.

Most neighbors beat it to the nearest window when "that electronic nut next door" starts scaling his roof or tower. The antics they see for free in his back yard beat television by a mile. A paid human fly won't tote thirty pounds of wobbling metal elements through tree limbs and power lines without a safety net below but a ham will, and gladly. Of course, the same fellow would shudder if offered a "risky" job like painting the house, and his wife has long since given up the perilous thought of getting him to fix the leaky roof.

Compared to a red-hot signal report from Formosa or Nepal, the danger of a compound fracture is nothing, so without batting an eye, amateur radio operators scramble over rooftops, scale towers, and shinny up tree trunks to get their antennas in the best possible places. Answering the call of the wild blue yonder, they can be spotted almost anywhere, anytime. In fact, if you see some sky-high object that isn't a bird, plane, or an out-of-orbit astronaunt, it's probably a ham. 73

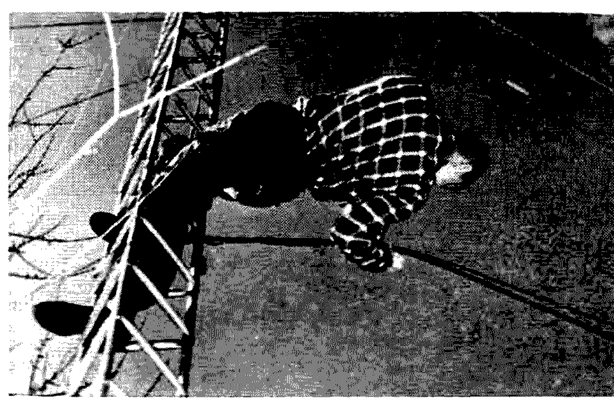
Part 2—something's caught! Jim, K9RUH, another Gary Ham, goes up to see if he can help get his buddy untangled. (Who says hams don't get exercise?)



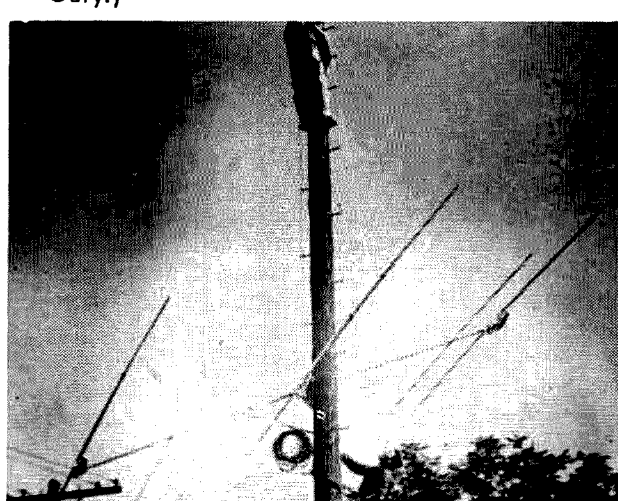


On top of the tower, Dick Pattie, W9VWJ, isn't quite sure what he'll do when the 20 meter beam reaches his height, but he'll give it all he's got. This is just one example of the "great sport" of amateur radio.

W9EZA, Dan Hoover, of Hillsboro, Illinois, is a typical ham dare-devil. Repairing the lead-in wire of his antenna 40 feet up is nothing, but he wouldn't think of doing a dangerous job like fixing the leaky roof.



Part 3—Mike is making progress now, but he has to leave the bean behind. When he gets to the top of the pole, he'll worry about the antenna. (This story has a happy ending as Mike has worked a lot of DX since this sunny day in Gary.)



Tubeless Electronic Key

How would you like to try something old, with a new twist? Here is an item that will stir the imagination of many a cw operator, who can't afford to sink a weeks wages into one of those "new fangled" gadgets called an Electronic Key. The offspring of my junk box is shown in the photograph; a tubeless, transistorless Electronic Key. How does it sound? I'll bet you can't distinguish it from one of those high price jobs!

The key has its own built-in power supply, and forms the dot and dash characters through the use of high impedance relays operating in simple RC time constant circuits. The dots and dashes are self-completing, and the spaces are automatically formed between the characters.

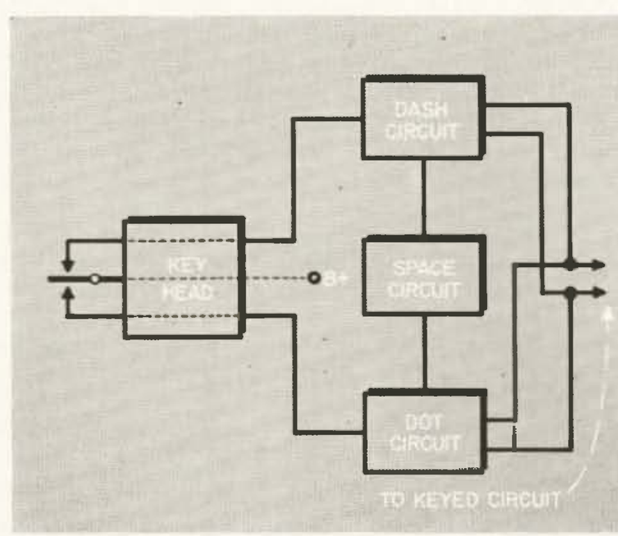
If the component values shown in the circuit diagram are used, the speed range of the unit will be approximately 10 to 25 wpm. However, after reading the circuit analysis (which follows) it will become clear that a circuit of this type can be modified to cover almost any speed range simply by changing the component values of the RC time constant, character forming circuits.

Circuit Analysis

Line power (115 v 60 cy) is applied to terminals 1 & 2 on the terminal strip. The conventional ½ wave rectifier power supply supplies approximately 90 v dc, which drops to about 75 v dc when the unit is keyed. Terminals 3, 4, and 5 on the terminal strip are wired to the key. Terminal 3 energizes the DASH relay (K1), terminal 4 is the common lead to the key, which supplies B+ power to terminals 3 or 5, depending upon the position of the key, and terminal 5 energizes the DOT relay (K3).

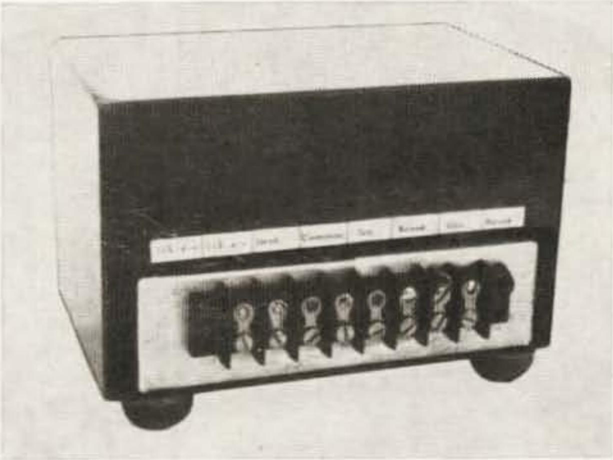
The operation of both the dot and dash circuits are similar. In the dot circuit, however, the actual speed of K3 is controlled by the potentiometer across the relay coil. The capacitor (C5) introduces a slight amount of delay helping to form the weight of the dots. Otherwise, the operation of the dot and dash circuits are identical; thus, only the operation of the dash circuit will be discussed in detail.

When terminal #4 is shorted to terminal #3 (the key being pushed to select a dash), dc power will be passed through a set of normally closed contacts on relay K2 (the space relay) directly to the coil of relay K1 (the dash relay), energizing relay K1 and charging capacitor C3. When K1 energizes, contacts on K1 apply dc power to the coil of K2, energizing K2 and charging capacitor C4. Another set of K1 contacts close, keying the transmitter. When K2 energizes, the dc power is removed from terminal #4 through action of another set of now open K2 contacts (assuming that the key is being held in the dash position). DC power is thus removed from K1. However, K1 does not release immediately due to the charge held by capacitor C3. When the charge



on capacitor C3 has fallen below the hold-in voltage of K1 (the time required depends upon the setting of P1), K1 de-energizes, breaking the transmitter circuit and removing dc power from the coil of relay K2. Relay K2 does not release immediately, due to the charge on capacitor C4 (the time interval depends upon the setting of P2). The set of K2 contacts in series with terminal #4 thus prevents B+ power from reaching the coil of K1 until C4 has fallen below the hold-in voltage of coil K2. When K2 does de-energize, K1 immediately fires

David L. Cabaniss W1TUW
165 Matthews Street
RFD #2, Bristol, Conn.



again, and the cycle is repeated, provided the key is held closed.

Relay K3 (the dot relay) operates in the same manner as relay K1, in conjunction with relay K2, except for the differences pointed out earlier.

Normally open contacts on both K1 and K3 are wired in parallel across terminals #6 and #8, to which the keyed circuit is connected.

In some speed ranges, capacitor C5 does not control the actual weight (or length) of the dot character. The weight (or length) of the dot character is controlled by the shunting effect of P3, changing the pull-in and drop-out point of K3.

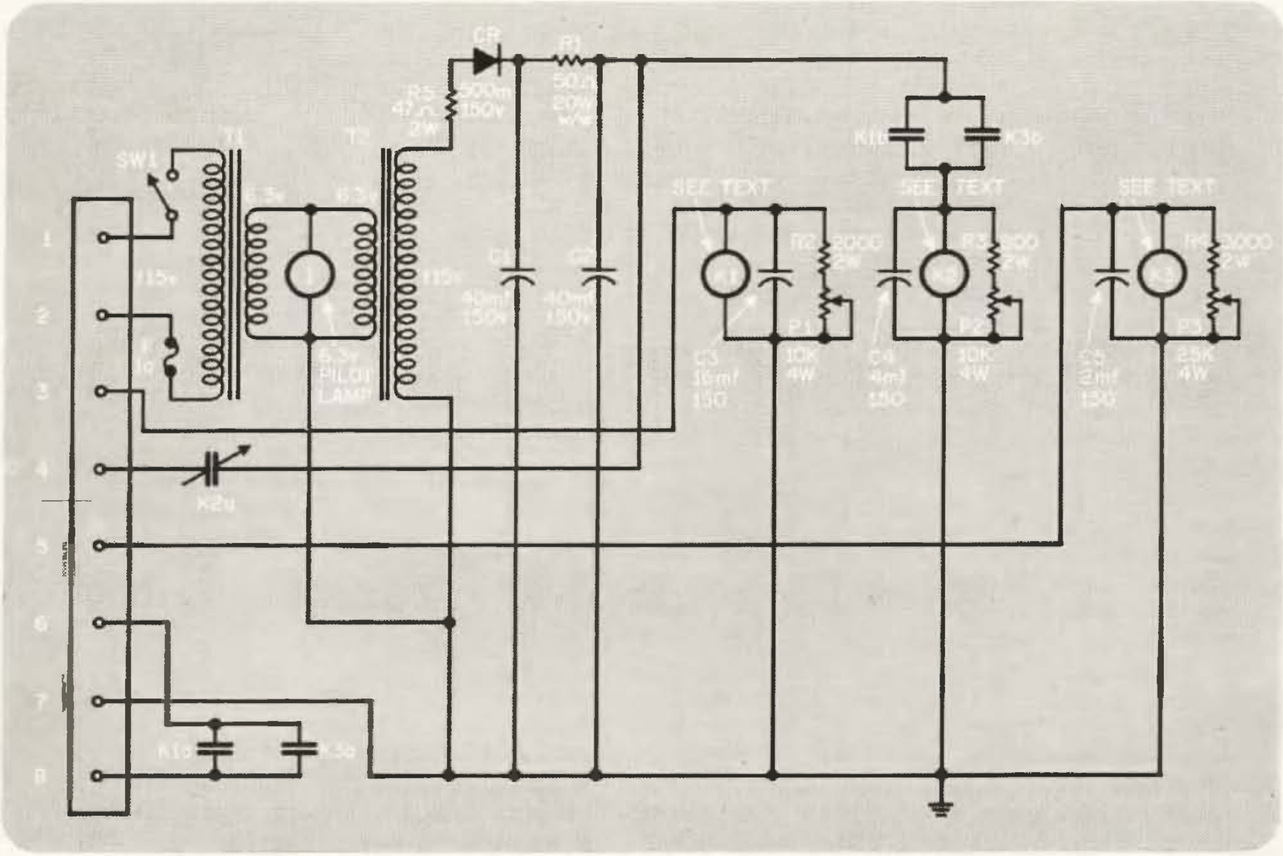
The extra set of contacts on K2 (see terminal #4) are not necessary, but were wired in parallel with the other set of K2 contacts because they were available and were used to help prolong relay life.

The power supply, as explained before, is a conventional ½ wave type. Although the circuit diagram shows 2 filament transformers back-to-back, a single isolation transformer may be used if one is available. If an isolation transformer is used, the pilot light should, of course, be changed to operate on 115 v ac.

Four factors should be pointed out when discussing the operation of this key. They are listed as follows:

1. Due to the mechanical and electrical limitations of the relays, complete coverage of the "speed range" is not

(Continued on page 56)



A Digest of Surplus Radio Equipment

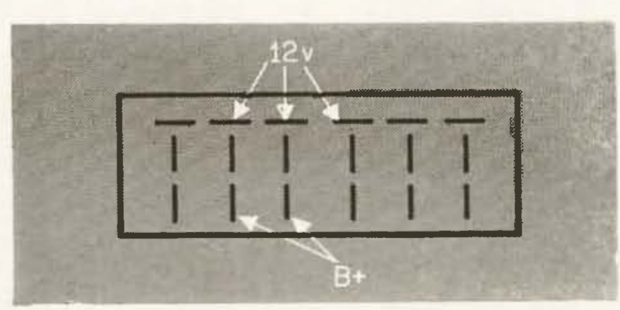
Gordon E. Hopper, W1MEG
75 Kendall Ave.
Framingham, Mass.

ARMY surplus radio equipment—today, after some twelve years of seeing ads and reading articles, even books, on it, we find is still with us. This article is written mainly to assist those who wish to experiment with commercially built equipment. It is a well-known fact that making changes in amateur commercially built gear will materially affect the resale value of the piece (as the author has found out the hard way).

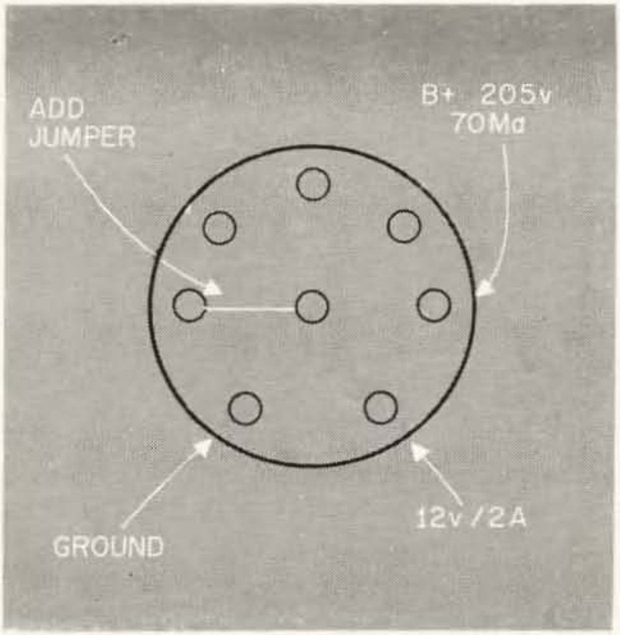
If you are the type of ham who thinks of making changes in the construction or performance of a piece of commercial gear, then, this article is for you. If you desire the satisfaction of seeing a piece of equipment designed for a specified service revamped into something that you, as a ham, can make good use of, then this article is for you. If you are a newcomer and want to get on the air with a minimum of cabbage outlay, then this article is for you. If you have read complicated articles on converting surplus gear and decided there was too much work involved, then this article is for you. If you have looked into a unit and found a maze of cables and multi-contact unidentified connectors and thought "I can never figure this out" then this article is for you. If you are a MARS member with unconverted gear, then this article is for you.

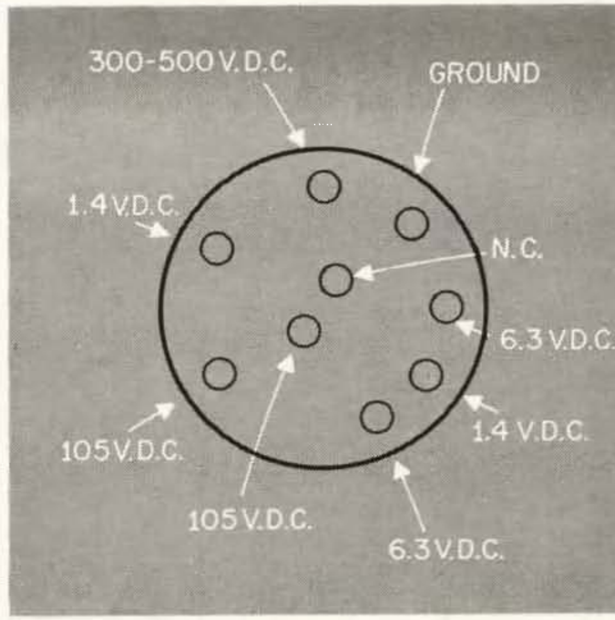
Now that everyone is digging out pieces of gear bought years ago, or getting ready to take off for their nearest surplus supplier, or starting to read more closely the numerous surplus ads, let us consider one thing. Most hams who have never converted any gear have refrained probably because they don't know where to start the job. This article will identify the power connectors of a few of the most usable and most easily obtained pieces. It will not show you how to completely convert a unit, but it will save you many hours of circuit tracing by showing you where to apply voltages. Once you get the unit operating then changes can be made to adapt it to your use.

The first connector to be shown is that of a BC-603, an FM receiver built like the proverbial brick battleship, designed to operate 20-27.9 mc. Articles in September and October 1958 CQ tell you how to get this receiver up to six meters AM, a formidable achievement. Applying voltages to the power connector, with no other changes, will get this receiver operating in the service it was designed for. Make the power supply connections to a Jones S-318CCT plug.



Next is the connector on the rear of the RBM-3 and RBM-4 receivers. The RBM-3 covers 2 to 20 mc. while the RBM-4 covers 20 to 2000 kc. Both are superhets and require only the addition of power supplies.

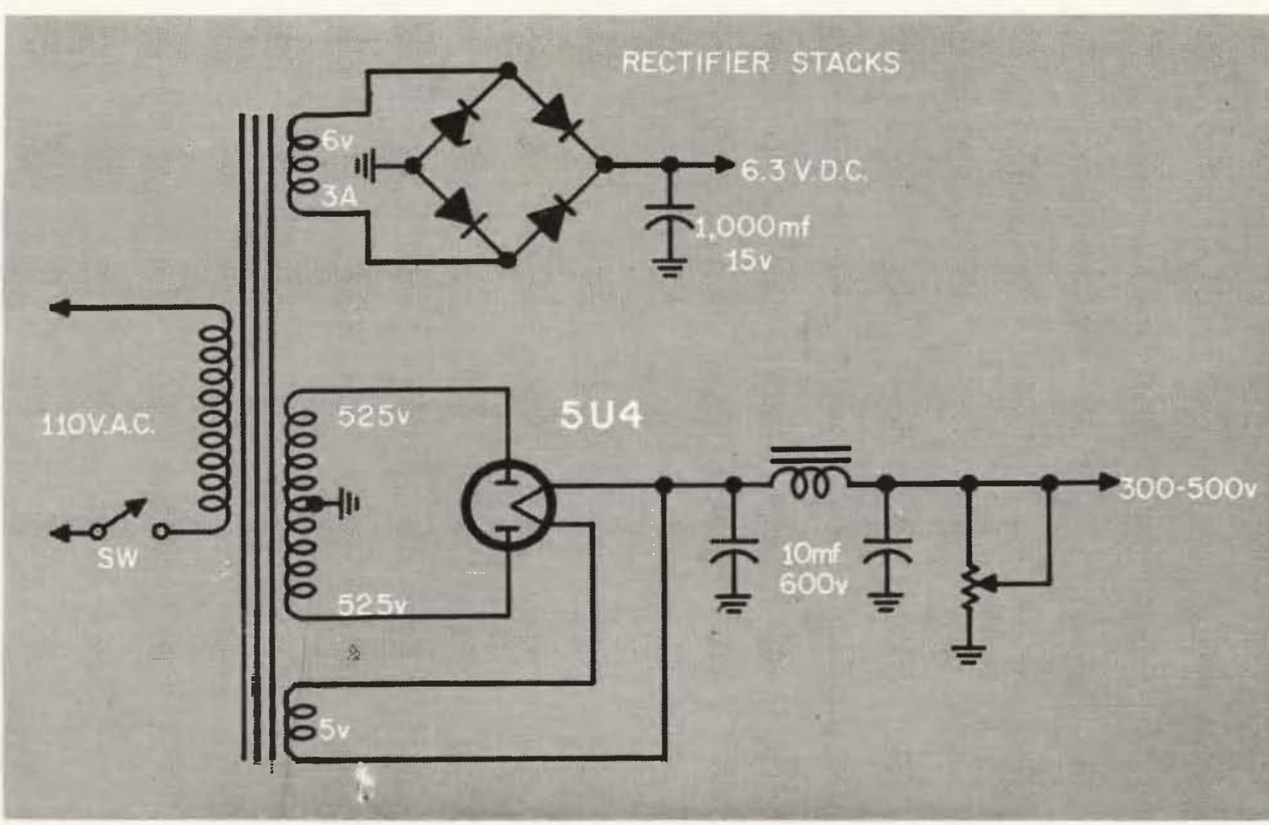




Now comes the BC-1306. This is a transmitter and receiver housed in one unit covering 3800 to 6500 kc. phone and cw. It requires an external dc power supply and no modifications. This unit has recently appeared on the surplus market and the following connector identification together with a suitable power supply should be of interest to these who are members of Army MARS who have not tried it yet. The author used a connector from a defunct BC-375E, however, suitable connectors can be obtained from Fair Radio Sales, 132 South Main St., Lima, Ohio, and from Connector Corp. of America, 137 Hamilton St., New Haven, Conn. Also worth nothing is the fact that a 6/12/24 volt mobile supply. PE-237, is available from the same Fair Radio Sales and also from Telemarine Communications, 140 West Broadway, N. Y. C.

(Continued on page 57)

A Suitable Power Supply for the BC 1306



"The Capacity Meter is a compact yet versatile test instrument."

Roy A. McCarthy, K6EAW
737 W. Maxzim Ave.
Fullerton, California

Direct Reading Capacity Meter

Of all the various methods of capacity measurement, the direct reading capacity meter has the greatest appeal from the standpoint of operating convenience and rapidity of measurement. The capacity meter is of course a great help to those who have difficulty remembering the myriad of color codes, as well as those of us who may have color perception deficiencies. Equally useful is the ability to measure the capacity of a length of coax cable to determine if there is a break close to the end where it is easily accessible for repair. Odd lengths of antenna can also be readily measured to enable calculating the amount of series inductance needed for resonance at lower than the natural resonant frequency of the antenna. Many other odd jobs can be quickly accomplished with the aid of a portable capacity meter, such as measuring stray wiring capacitance, locating breaks close to the surface in coils, breaks in line cords, etc. An ohmmeter will tell you a cord or cable is open, but a capacity meter will tell you where.

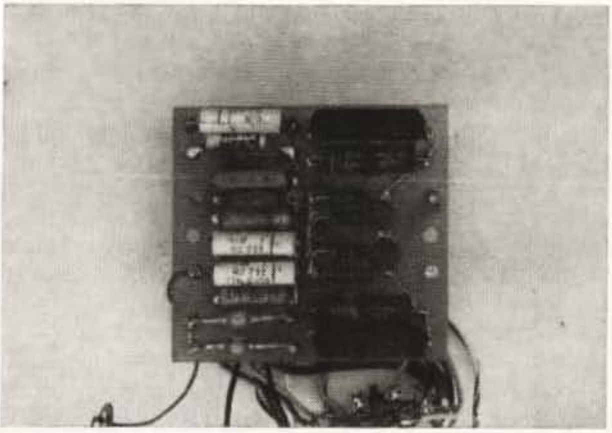
The instrument was transistorized to add to the convenience of operation and eliminate the need for power cords, or waiting for it to warm up and settle down. Along this same line, the meter is large and easy to read accurately, and the small case with a carrying handle compares favorably with most standard multimeters.

Ranges

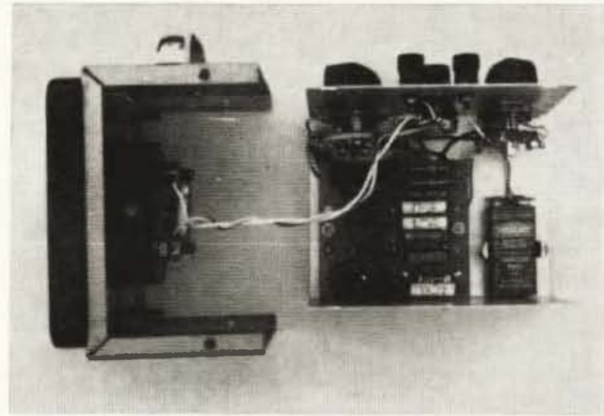
Four basic ranges were provided, calibrated at full scale by means of the built-in standard capacitors of 100 mmfd, 1000 mmfd, .01 mfd, and .1 mfd. By means of the built in standards and the calibration control other ranges may be used to increase the ease of measurement. For example, a capacity which read just off scale on one range would be slightly above 1/10 scale on the next range. Instead, by re-adjusting the calibration control, so the calibrating capacitor read ½ of full scale, an unknown capacitor just slightly larger can be readily determined, using a mental multiplier of two. Although the author's instrument has an apparent residual capacity of about 0.8 mmfd, capacitors as low as 1 mmfd can be measured if this residual capacity is allowed for and subtracted from the indicated reading.

Accuracy

The accuracy, as well as the cost of the instrument will depend mainly on the basic meter selected and the four standard or selected capacitors. The transistors are fairly



Use of a component board greatly simplifies wiring, with connections made to the underside of the board.



Inside view of the capacity meter shows the compact construction made possible by use of miniature components.

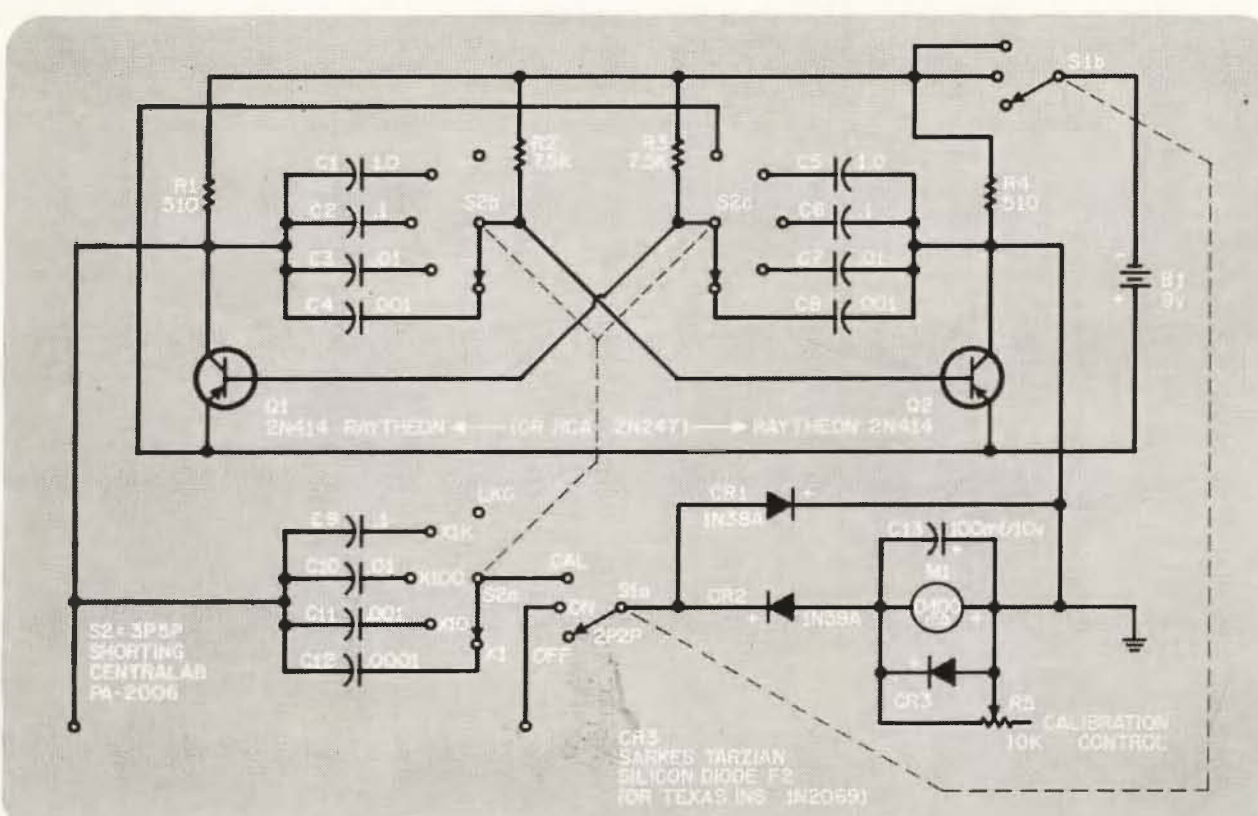
inexpensive rf or if type PNP units. The mercury battery shown in the photographs is not really a necessity for any dry-cell type can be used if it has enough voltage and can maintain a steady full scale reading on all operating ranges. The multivibrator used in the circuit is quite stable, hardly changing frequency over wide supply voltage variations, and in any case each range is normally calibrated by the built-in standards before use. The author obtained 1.0% of full scale accuracy on the three higher ranges, and 3 to 4% of full scale accuracy on the 100 mmfd range. This does not mean that a very low capacity may be off 3 or 4 mmfd, since zero is mechanically set by the meter adjustment screw. The error was greatest near the center of the scale.

Theory of Operation

The circuit operates by measuring the amount of charge which the capacitor under test receives by the application of a squarewave from the multivibrator. A pair of diodes in a simple rectifier circuit enable a microammeter to be used as the indicator. Since the amount of charge on a capacitor, with a given voltage applied, is directly proportional to the

(Continued on page 41)

Fig. 1. By proper wiring the residual capacity indication is easily reduced below 1 mmfd.



TRAFFIC through the medium of the "phone patch" is becoming increasingly popular and is another service added to the already long list of those provided by the radio amateur.

Disregarding the technical aspects of the "phone patch", this type of traffic is tricky to handle. This is due to the human element injected by the usually uninitiated person on the other end of the telephone line. There are several do's and don'ts that are well worth your attention if you handle or intend to handle this type of traffic.

Before placing the telephone call, be sure you have all of the necessary information; that is, the addressee's name and complete phone number, as well as the name of the originator. You should also check to see if there is any toll charge involved. If there is, be sure to get the approval of the originator before placing a collect call.

cause of amateur radio. Who knows, this person may be the one who's giving the "ham", two doors down the block from him, multiple fits with his TVI complaints. Don't miss the chance. Explain briefly, but thoroughly, what is going to take place. Be sure to mention that, as a radio amateur, both you and the operator of the originating station are proud and happy that your hobby permits you to perform this service for him. Also, inform him that there is no charge or obligation on his part.

Determine whether or not he is familiar with "phone patch" operation. If not, instruct him as to the procedure you wish him to follow and to speak slowly and clearly so that his voice may be easily understood at the receiving station.

After switching the "patch" into the circuits, it may be advisable to turn it back to the originating station. This is particularly useful when the person is not used to "patch-

"Gotta' Phone Patch?"

Ken Johnson W6NKE
21835 Rodax Street
Canoga Park, California

The "phone patch" should not be switched into your station's circuits while you are placing the call. In some cases, your transmitter will be on the air and the initial remarks made by the party you are calling may be confusing or even disastrous. For example, the following reaction of surprise could happen. Suppose you've just informed the person on the other end of the line that his old service buddy, Joe, is going to talk to him through your amateur radio station. "Joe! My old buddy, Joe", the voice on the other end of the line says, "the h— you say! I haven't heard from that dogface for ten years. Put him on so's I can hear his d— old ugly voice".

See what I mean? It may read funny but can't you just see yourself frantically snatching at the switches?

This, too, is important while placing a collect call. Most telephone operators seem to be familiar with amateur radio and phone patches. It has been my experience that all of them are cooperative. However, occasionally it becomes necessary to explain what you are trying to do and it's needless to put the ensuing conversation on the air. Also, her placement of the call may create some excitement and confusion on the part of the addressee until he understands what is going on. There is the possibility of unnecessary embarrassment if your patch is in the circuit during this time.

When you have the addressee on the line, you have one of the most desirable situations possible to do a little publicity work for the

ing". It shifts the responsibility of starting the conversation to the originator who has had plenty of time to think of what he wants to say.

Carefully monitor the conversation from beginning to end. Remember that there are definite regulations as to the type of traffic that may be handled via amateur radio. Remember also the type of language that may

(Continued on page 54)

"FRANTICALLY GRABBING FOR THE SWITCHES"

(. . . de W2NSD from page 4)
advertisers that you see in these pages. Make this generosity worth their while . . . read the ads carefully . . . send for more information on their products . . . give them a boost . . . maybe even drop them a card of appreciation.

And when you write to them *be sure to tell 'em you saw it in 73.*

Coming Up

Naturally we wanted to put a lot of goodies in this first issue of 73. But we were careful not to unbalance it at the expense of future issues. Here are some of the articles scheduled for the November issue that may be of interest to you:

"VHF Receiver" This is a rather complete basic receiver that is designed to go with the *Bantam Converters* described in this issue. It gives you everything you could ask. This is quite an elaborate construction article, running to five pages, but you'll have a heck of a job fighting off the urge to build when you see it.

"Four Band Crystal Converters" This is a combination product report and construction article which shows how to use the International Crystal converters to good advantage. In this package we find the 20-15-10-6 meter converters all built into one band-switching converter unit, complete with power supply.

"An FM VFO Exciter" A BC-459 is converted into an FM VFO for use on 10, 6 and 2 meters, using either narrow-band or wide-band FM. With more and more FM turning up in our ham VHF bands it is nice to have an exciter around that will generate a usable signal for either FM or AM type VHF receivers.

"Notes On Mobile Power" Higher power from the car using an alternator and a three-phase power supply. Output is 520 volts at 500 ma.

"Stop That Noise" In this issue we have a good technical article on modulation. In November we go into detail on the subject of noise limiters and give the circuits of all the popular types, complete with an interesting discussion of the advantages and disadvantages of each.

"$5 Frequency Meter" Two transistors are used in a new type of circuit which will probably be turning up in a commercial unit very shortly. This will give you a direct reading of any frequency in the ranges of 300 cps, 1 kc, 3 kc, 10 kc, and 30 kc. If this article doesn't get you to the work bench then you're an out and out non-building type ham.

There will be about ten other articles. We don't want to give away the whole thing right here. It will be a good issue and worth well over the yearly subscription price all by itself.

Policies

Here are the basic policies which will guide 73.

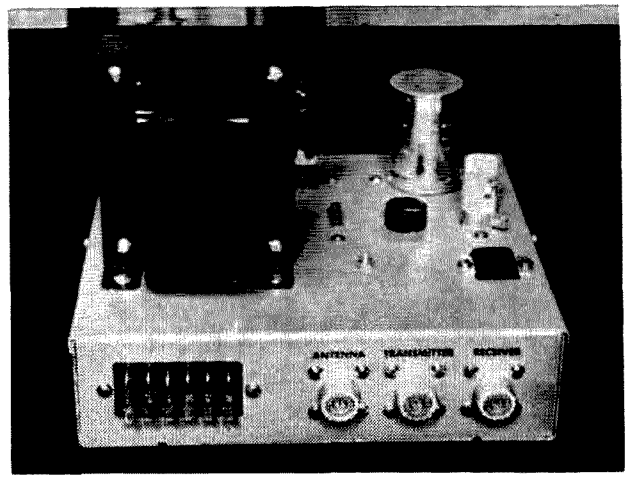
Policy #1: We are not mad at anybody.

Policy #2: Amateur Radio, in its dual role as a means of arousing the interest of youngsters and providing the basic training for entry into the field of electronics, one of the largest and most promising fields we can see ahead, and as one of the most important means of communications between the peoples of the world on a people-to-people basis instead of through the press or government channels, is probably the most important hobby in the world today. We can keep it important by being aware of what is going on in our hobby and by being technically up to date. 73 Magazine is dedicated to bringing into focus the frontiers of amateur radio. It will strive to broaden the technical interest of the amateurs and to encourage them to higher technical attainments and abilities by means of technical and construction articles written by the best talent available.

Policy #3: Few talented writers have continued to buck the present system whereby they either receive nothing for their efforts or else have to wait from one to three years for minimal pay. 73 has established the policy of paying for all accepted articles with immediate cash. This seems to be bringing new life to the field for we are receiving top notch articles by some of the best authors in the hobby.

Policy #4: It is our intention, the SEC permitting, to open the ownership of Amateur Radio Publishing, Inc., to interested amateurs so that the ownership of the magazine can be widespread and the magazine will be truly owned and run entirely by licensed hams. 73 is being run under a very tight economy until the break-even point of 15,000 circulation is reached.

Policy #5: We intend to encourage and promote the publication of bulletins to bring specialized operating news of the many facets of amateur radio: VHF, RTTY, DX, Traffic Handling, TV, etc. The Club Bulletin of Marvin Lipton VE3DQX will be one of the first under this program. This publication, which is sent to the editors of all known ham club bulletins to provide them with a means of exchanging ideas, should be back in business this fall.



DeLuxe Three-Way Power Supply

Donald A. Smith W3UZN
P.O. Box 45
Hagerstown, Maryland

Do you have need for a 6 or 12 volt power supply for your new Citizens Band transceiver or amateur rig? Would you also like to use the same supply for line voltage operation? Do you have a six volt automobile now and have held off building a mobile supply because you are going to buy a new car with a 12 volt system in the near future? Here is a power supply which will fit these requirements and more!

The power supply shown in the photos has these features:

1. The supply will operate from 6 or 12 volts dc and 120 volts ac.
2. NO circuit changes are required to change from one input voltage to another!
3. The supply has built-in change over relay, permitting B+ output voltage to be switched from receiver to transmitter.
4. This B+ change over may be accomplished by throwing the switch marked "HI VOLTAGE," or it may be done from a remote location.
5. The antenna is also switched from receiver to transmitter when this switch is thrown.
6. A green pilot lamp indicates when the power supply is on and a red one lights when the supply has been switched from receiver to transmitter.

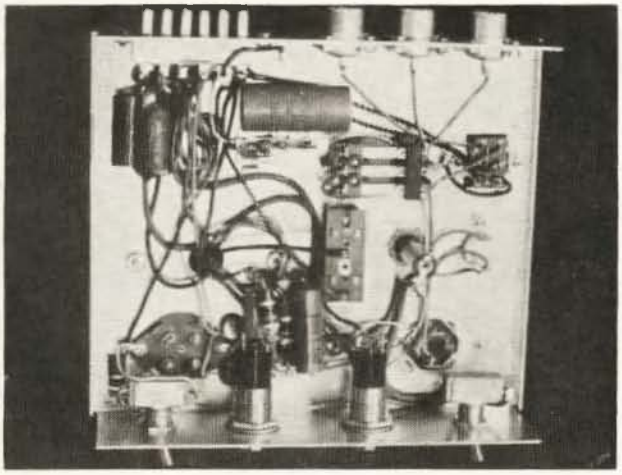
This changing from one input voltage to another is accomplished by making a separate power cord for each input voltage. As can be seen in the photographs and the diagram, an 18 prong Jones plug is used as the input voltage connection. Depending on what input voltage is desired, a Jones plug is wired for the connections required for that voltage. For using the supply on all three input voltages, three different cords are made. The connections for each input voltage are shown in the table.

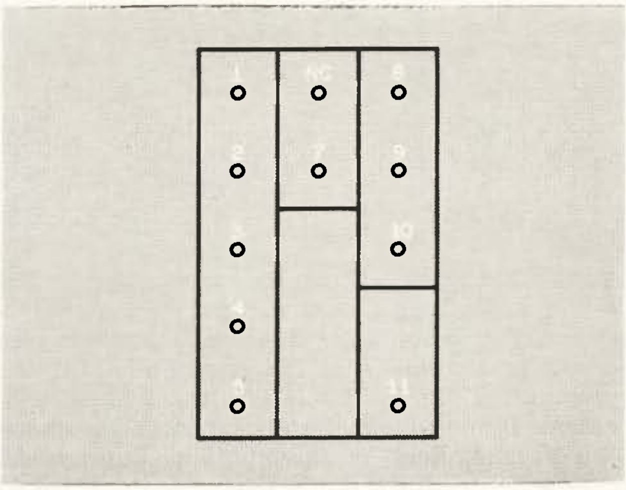
Output from the supply is approximately 275 volts dc at 100 ma, more than ample for many Citizens Band rigs which do not have this three way feature, as well as a number of amateur transmitters. If desired, the supply can be used to operate your favorite communications receiver in your car. Many of these receivers are provided with a connector on the rear of the chassis for just such a purpose.

The supply uses the parts from two basic kits available from International Crystal Co. in Oklahoma City. The additional parts required are listed in the parts list. These two kits are used rather than purchasing the parts individually because the power Xformer is special, and the cost of the individual parts is considerably higher than the price of the two kits. The total price of the Deluxe Three-Way Supply should be around $35.00, if you have no parts on hand.

Note that only one Jones power connector comes with the kit. It may of course be wired for any of the three input voltages. Additional plugs may be purchased from International, or from your local parts supplier. The part number is Jones S-318-CCT. Amphenol UHF jacks are used for the antenna connectors to keep losses to a minimum. These are positioned on the rear of the box chassis as shown in the photos.

(Continued on page 46)





View, Facing Relay Connections (Relay Has No Numbers)

CONNECTIONS FOR INPUT VOLTAGE POWER PLUGS–

6 Volts dc

6 Volt "Hot" lead (May be either + or —) Pin 1
6 Volt Ground lead–Pin 14
Place Jumpers between the following pins
2 & 5
6 & 8
8 & 11
7 & 10
9 & 12
5 & 17
15 & 18
15 & 16

12 Volts dc

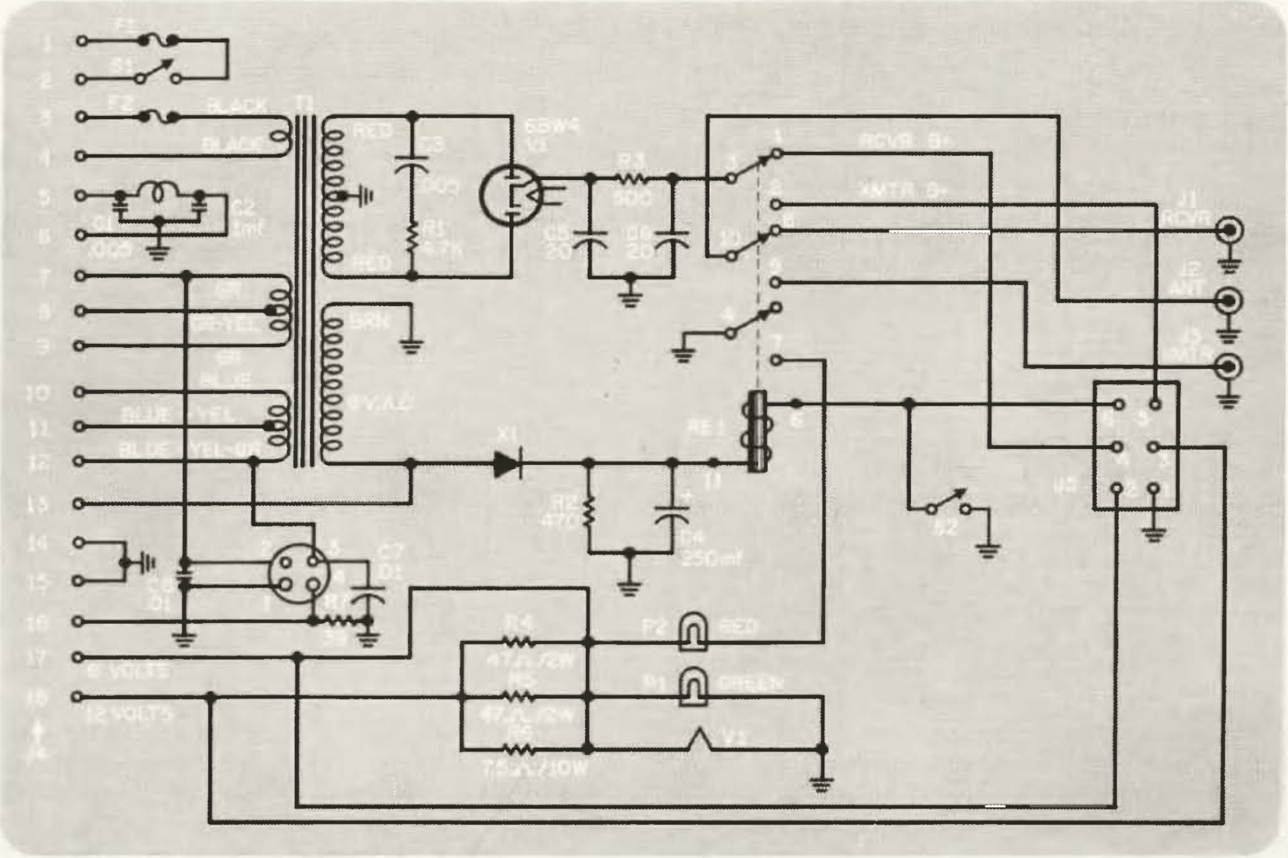
12 Volt "Hot" lead (May be either + or —) Pin 1
12 Volt Ground lead–Pin 14
Place Jumpers between the following pins
2 & 5
6 & 9
9 & 10
5 & 18

120 Volt ac

Line cord, one lead to Pin 1 and the other to Pin 4
Jumpers between the following pins
2 & 3
13 & 17
15 & 18

PARTS LIST

1—Three way basic power supply kit, PW-2F.
1—Relay Kit for above.
(The above from International Crystal Co., 18 N. Lee St., Oklahoma City, Okla.).
1—L.M.B. Box chassis No. 20.
P1—Jones #S-306AB, 6 prong power output plug.
S1—S2 Single pole, single throw toggle switches.
J1—J2—J3 Amphenol UHF connectors, #83-1R.
P1—P2 Dialco #81410-111 Jeweled pilot lamp holders. Red for P2 (transmitter) and green for P1.
R4—47 ohm, 2 watt resistor.
R5—47 ohm, 2 watt resistor.
R6—7.5 ohm, 10 watt resistor.
NOTE: All other parts are supplied with the two kits listed above.



Shock

Peggy Bates

IN 1917 a squad of soldiers was being drilled on a field at Niagara, during a thunderstorm. Bayonets were fixed, and stood up in a row in the hands of the men. Suddenly, the unexpected happened—a bolt of lightning crackled down from the darkened skies, struck the bayonet held by the end man, and rolled, a blue flame, down the entire row, to that held by the man at the other end of the line.

Every man in that row was knocked unconscious for a while, but the two men on either end of the line failed to recover. Upon examination, they showed all recognized signs of death . . . no breathing, no eye reflex, and no heartbeat.

The officer in charge thought that this would provide a good opportunity for the men to practice artificial respiration, and instructed them to work over one of the bodies, then left the field to return to headquarters. A few hours later, one of his men came running, breathless, to announce that the "body" they had been practicing on was exhibiting a remarkable reluctance to die, and was sitting up and insisting upon the fact that he was alive at the top of his lungs.

This was one of the first intimations that victims of electrical shock may not necessarily be dead at all, but may be revived through immediate and prolonged application of artificial respiration.

On May 20th, 1927, a young lineman working for the hydro came into contact with 26,000 volts at 2 o'clock in the afternoon. He was unconscious, and not breathing. However, he was lowered on the ground, and artificial respiration was started by fellow employees. This was continued on the floor of the ambulance while he was being transported to the hospital, and also on boards on top of a cot at the hospital. Communication was established between the local doctor and consultants in a large city, and it was not until 10 o'clock at night that the man was breathing by himself.

In this case, *eight hours* of artificial respiration were applied continuously until the victim revived. This is the longest case of resuscitation from electrical shock on record.

There are many instances of such dramatic revival of victims of electrical shock, and yet only this summer, a man visiting Orillia, Ontario, standing on the wet concrete surrounding a swimming pool received 110 volts while helping to install a PA system, and died. There is no indication in the newspaper report of the incident that any attempt was made to revive him.

Every year, approximately 100 radio hams die through their hobby in the United States alone, and many others through other forms of electrical shock. Were these people really dead? How many of them would be alive today if artificial respiration had been started at once and continued until *rigor mortis*—the only unmistakable sign of death—set in?

The victim of electrical shock will look just as "dead" as a victim of drowning or of gas asphyxiation—dead enough to convince even doctors and coroners. One drowning victim in Canada was indeed pronounced dead four times by the same physician, and yet revived after eight hours of artificial respiration applied by relatives and neighbors who refused to give up hope. Today, some 30-odd years later, that victim in still alive.

The Health League of Canada became interested in the matter of reviving apparently drowned persons in 1938, under the leadership of the late Sir Frederick Banting, and were impressed by the similarity between revival of drowning victims and those of electrical shock. The League collaborated with the late Willis MacLachlan, of the Ontario Hydro Commission, which body had been actively interested in the matter since 1917.

It was discovered that while it still held true that revival depended upon immediate and prolonged application of artificial respiration in the case of both electrical shock and drowning victims, there were some important differences.

In the case of drowning, victims have been revived who have been under the water for periods of up to half an hour. In the case of electrical shock, *no such long period is possible.* Resuscitation must be started as *immediately* after the contact as possible. It has been found that where artificial respiration was started within one minute of the electrical shock, 90 per cent of the victims were revived; where there was a delay of six minutes, only 10 per cent were revived. Victims of electrical shock have been returned to life after a delay of ten minutes, but the chances of revival lower with the delay.

The outward deathlike symptoms of drowning and electrical shock seem the same—no breathing, no eye reflex, and no perceptible heartbeat. However, the inside story is different. Death may come through a larengeal

spasm in drowning, and the victim dies through asphyxiation—or, as often occurs, the victim may *seem* dead, but the heart is still beating, not normally, but in a state of fribillation, detectable only with the use of an electrocardiograph, an indication that life is still actually present, although the victim is often given up for dead, and no attempt made to revive him.

With electrical shock, the respiratory nerve center is paralyzed. The current in its passage through the body damages the sensitive nerve cells of the respiratory center. They become paralyzed and insensitive both to the accumulation of carbon dioxide and the lack of oxygen in the blood. No stimuli are sent to the respiratory muscles, and breathing stops. Here again, are the symptoms of "death" which are apparent in cases of drowning victims—symptoms which have prevented attempts at revival which may well save the victims' life.

The nerve cells tend to recover if they have an adequate supply of oxygen. An adequate supply of oxygen depends not only upon effective artificial respiration, but also upon the presence of circulation—in other words, the heart must be beating.

In some cases, where the victim has been well grounded, and the current passes directly to the heart, revival may be impossible. However, as in the case of drowning, the heart may beat so gently, that a doctor cannot pick up the beat with his stethoscope, and the victim may yet be alive.

This beat, in electrical shock, and although the heart may have received the current, may yet be effective enough to provide sufficient circulation to provide oxygenated blood to the nerve cells in the brain, but the *heart itself needs oxygen.* It is essential, therefore, that artificial respiration be started *at once,* in order that supplies of oxygen be made available both to the heart and to the nerve centers in the brain.

Two methods of artificial respiration are used by electrical utilities companies — the Holger-Nielsen, where the operator works facing the prone body of the victim, and the Schaeffer, where the operator works astride the victim. Of the two, the Schaeffer is considered the most effective, for in cases of electrical shock the blood had a tendency to leave the upper part of the body, and concentrate around the abdominal region. The Schaeffer method is most effective in recirculating the blood to the upper parts of the body more swiftly than the Holger-Nielsen.

Once again, though, much depends upon circumstances. If a man has been shocked while working on a pole, chances are that the upper part of his body will be burned too badly to bear handling—in which case the Schaeffer method is employed. If the reverse is the case, then the Holger-Nielsen is used. It is interesting to note that in the entire experience of the Ontario Hydro—Electric Power Commission no person has yet been successfully revived from electrical shock through the use of a mechanical resuscitator. These machines, of varying kinds, have been of use in the case of drowning victims, but never in the case of electrical shock.

Hard and fast rules cannot be laid down in electrical shock — depending upon the circumstances, 30 volts can kill—or as has been shown, a man can survive 26,000 volts.

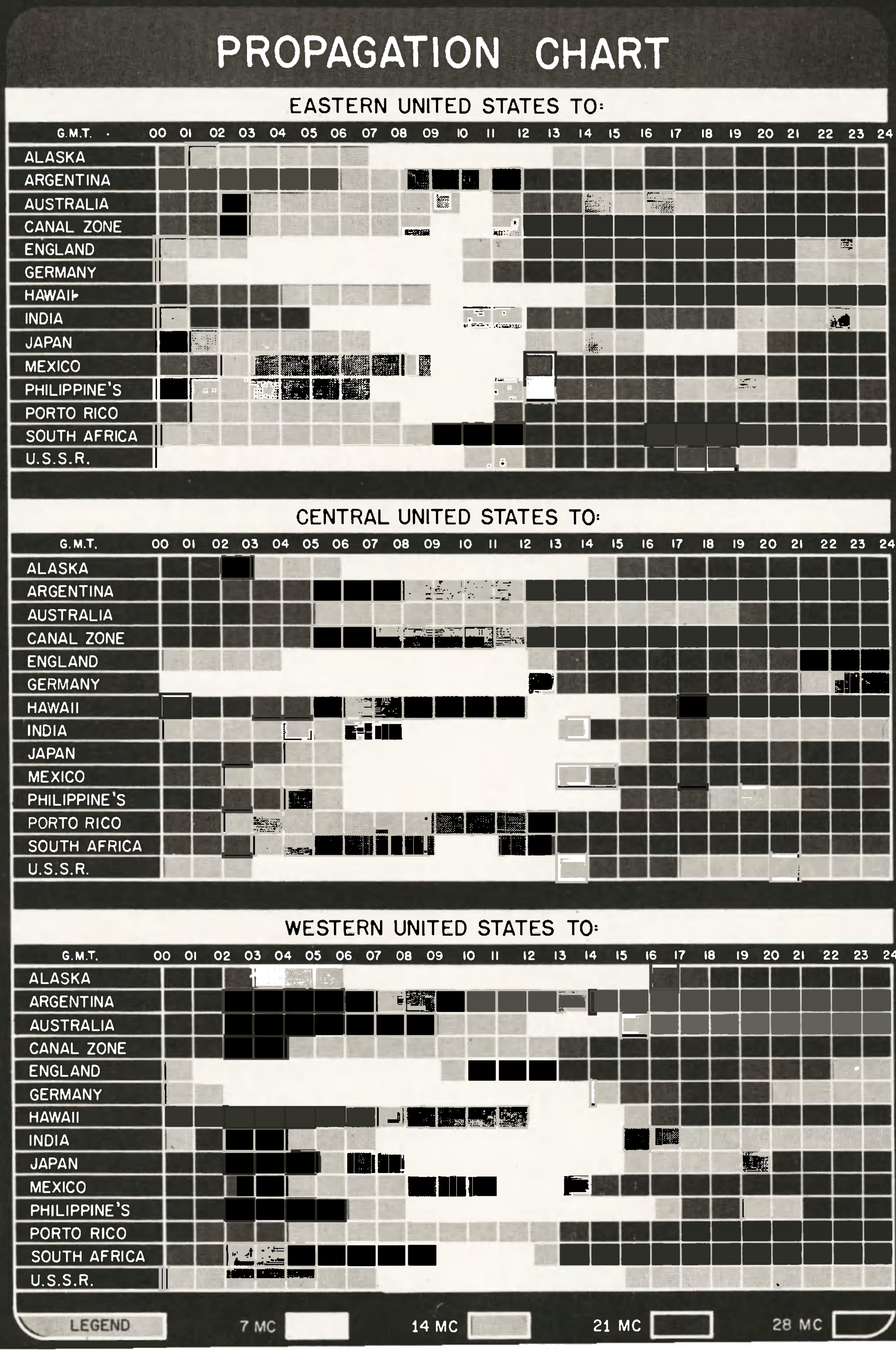
The main thing is that victims will look dead, and may remain so, if immediate help is not given—*and kept up until rigor mortis sets in.* This is so important that the Ontario Hydro insists upon every member of its 17,000 work force knowing how to apply artificial respiration. All those working directly with electrical apparatus must have regular practice sessions, and the head office staff can take lessons during vacation periods. They all have instructions not to cease until rigor mortis sets in. It is interesting to note that in the annals of men, women and children who have been revived from drowning or gas asphyxiation, the life saved has been due to the prompt action of a Hydro employee who has been in the neighborhood at the time.

A wife or friend, coming into the room and finding the ham prone on the floor, looking extremely dead, is apt to run for the doctor, or waste time screaming. Don't do this! Death may really come in the time it takes to run upstairs, look up the telephone number, and dial.

Take a stick, remove all wires touching the "body" — and start working! The ham you save may be your own!

The Schaefer Method

1) Turn victim on stomach with head slightly lower than feet.
2) Make sure mouth is clear for breathing.
3) Extend both arms beyond head. Bend one at elbow and place victim's cheek on back of hand.
4) Straddle victim and place hands on victim's back, fingers close together over the lower ribs.
5) Keeping your elbows straight rock forward and bring your shoulders over the heel of your hands, bearing down on the victim's back and lower ribs to expel air from the lungs.
6) Rock backward to an upright position, removing the hands without a push. This permits the air to enter the lungs.
7) Allow about two seconds for each move, five seconds per complete cycle (12 to the minute).
8) Continue without interruption to rhythm until normal breathing is resumed or until rigor mortis sets in. 73


PROPAGATION CHART
EASTERN UNITED STATES TO:
G.M.T.
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
ALASKA
ARGENTINA
AUSTRALIA
CANAL ZONE
ENGLAND
GERMANY
HAWAII
INDIA
JAPAN
MEXICO
PHILIPPINE'S
PORTO RICO
SOUTH AFRICA
U.S.S.R.
CENTRAL UNITED STATES TO:
G.M.T.
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
ALASKA
ARGENTINA
AUSTRALIA
CANAL ZONE
ENGLAND
GERMANY
HAWAII
INDIA
JAPAN
MEXICO
PHILIPPINE'S
PORTO RICO
SOUTH AFRICA
U.S.S.R.
WESTERN UNITED STATES TO:
G.M.T.
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
ALASKA
ARGENTINA
AUSTRALIA
CANAL ZONE
ENGLAND
GERMANY
HAWAII
INDIA
JAPAN
MEXICO
PHILIPPINE'S
PORTO RICO
SOUTH AFRICA
U.S.S.R.
LEGEND
7 MC
14 MC
21 MC
28 MC

Propagation Charts

These charts are to be used as a guide to ham band openings for the month of October, 1960 to the various countries listed. I will be interested to hear of your results in using these charts and to know what other areas you might wish included in future charts.

David A. Brown K2IGY
60 New York Avenue
West Hempstead, N. Y.

TO HAVE reliable communications between any two points we must choose a frequency that is low enough to be reflected from the upper layers of the ionosphere and yet not so low that ionospheric absorption makes it necessary to run excessive power. Too high a frequency, one that is above the Maximum Usable Frequency (MUF), will skip over the intended receiving point.

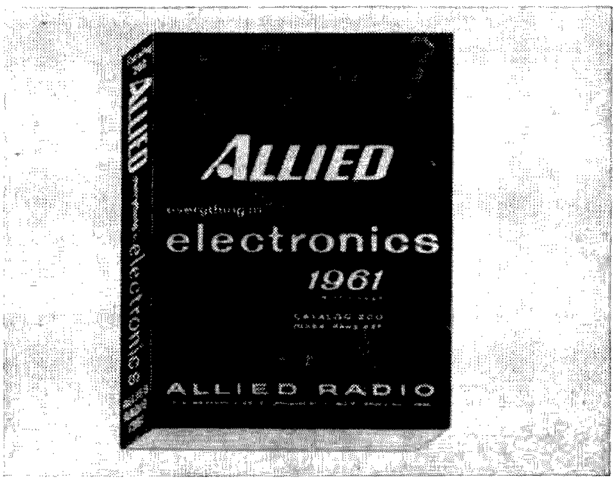
We can predict the MUF by interpretation of charts made by the National Bureau of Standards' Central Radio Propagation Laboratory. From these charts I have made up three charts covering transmission from eastern, central, and western United States to various countries. The bands listed are MUFs and a higher band will not work for the time period listed. Lower bands will work, but not nearly as well. Times are GMT, not local time. 73

Advance Forecast: October 1960
Good: 2-6, 8-10, 13-16, 18-20, 28-31.
Fair: 1, 7, 12, 17, 21-22, 26-27.
Bad: 11, 23-25.

New Products

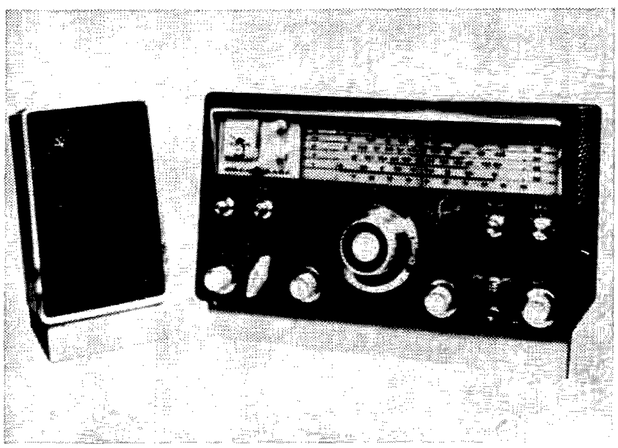
Allied Catalog

This is a little redundant since Allied has taken a full page ad in this issue (bless their heart) to try to get this catalog into your hands. They don't carry every brand of equipment, but you will be hard put to discover what obscure brands they have omitted. This is, as far as we know, the most complete radio parts and equipment catalog put out by any distributor. Where else can you get 444 pages of interesting reading absolutely free? The new Knight-Kit line of ham gear is worth looking into also . . . like their 400 watt transmitter kit and a whole bunch of other items. But don't tell 'em you're writing in from this paragraph, point out that it was their ad that forced you to write . . . **their ad in 73** on page 64.



National 270

Somehow, down through the years, there seems to have been a welter of receivers that have hit the market with much hoopla, only to disappear from all but the most educated of memories in a short time. This is particularly true of the medium priced receivers. The specs on the 270 look mighty good. This may well be a receiver that will be with us for a while. It looks good, has all of the features we need for ham communications, and is strictly a ham-band (80 thru 6) receiver. If you want to have all the facts to mull over drop a line (mentioning this reference) to National Radio Company, Melrose 76, Mass. The price tag reads $249.95 plus 7.98% more for a matching speaker.



Capt. John J. Sury K8NIC/5
139 Nebraska Road
Dyess AFB, Texas

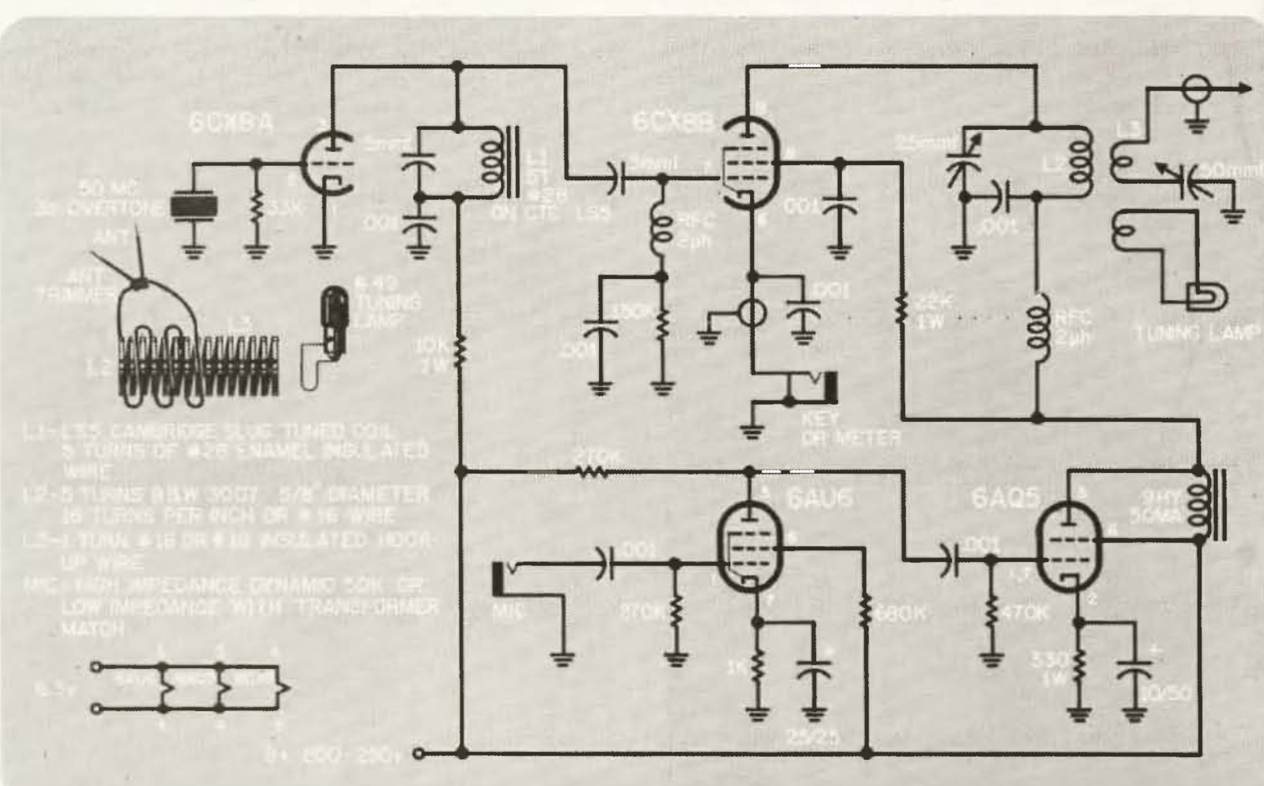
Tube Tube Tube Watt Watt Watt Watt Watt Meter Meter Meter Meter Meter Meter

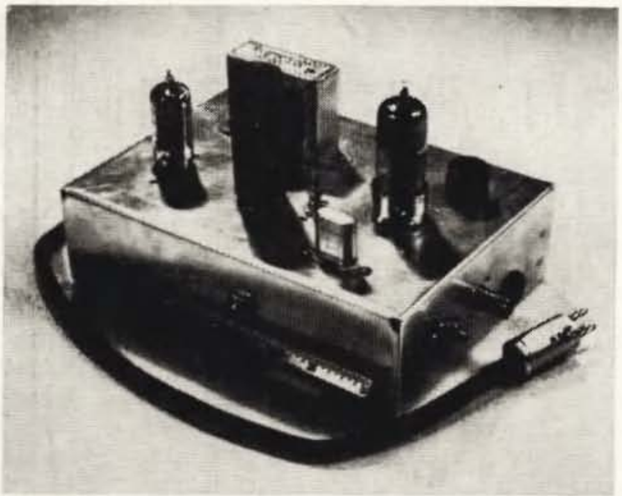
THREE tubes, five watts, six meters. And this li'l 'ol peanut whistle really puts out a bird call: I've worked over 30 miles with an indoor halo antenna plus many fine DX sessions when the band opened. Which isn't bad for a little handful of stuff which knocks together in a couple hours and won't even slim down that big fat wallet of yours to where it will stop wearing out your back pocket.

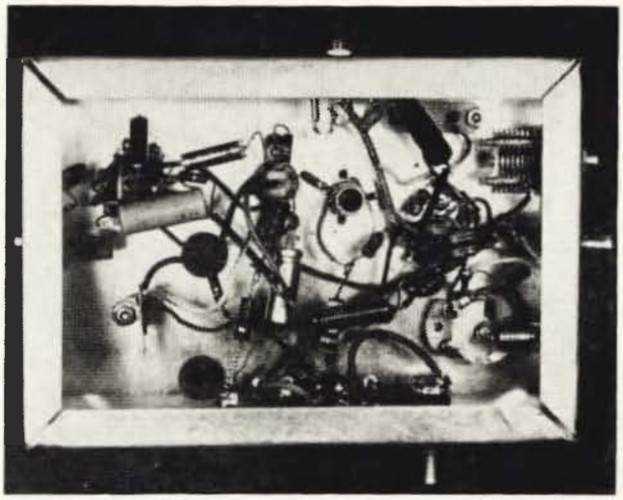
Simplicity, simplicity. An overtone oscillator and power amplifier occupy one set of tube prongs with the number 6CX8 above them. There may be a good pentode-tetrode tube around, but since I didn't have one I used a 6AU6 speech amplifier with a 6AQ5 Heising modulator. What you lose in modulation you make up in savings when you price a cheap filter choke for the executive position usually occupied by a modulation transformer. No one will ever notice the difference anyway, so why fuss about it.

While not much artistic effort went into the layout, it is electronically OK and may be imitated by you if you are in a rubber stamp mood, or if you're not sure enough of yourself to venture off the beated paths. A 5" X 7" X 2" aluminum chassis was used.

The oscillator coil was made by winding five turns of #28 enamel coated wire on a Cambridge (CTC) slug tuned coil form type LS5 (or equivalent). The coil is shunted with a 5 mmfd ceramic capacitor. L2 is five turns







Photographs taken by S/Sgt. Wilson Dodson, Dyess Air Force Base.

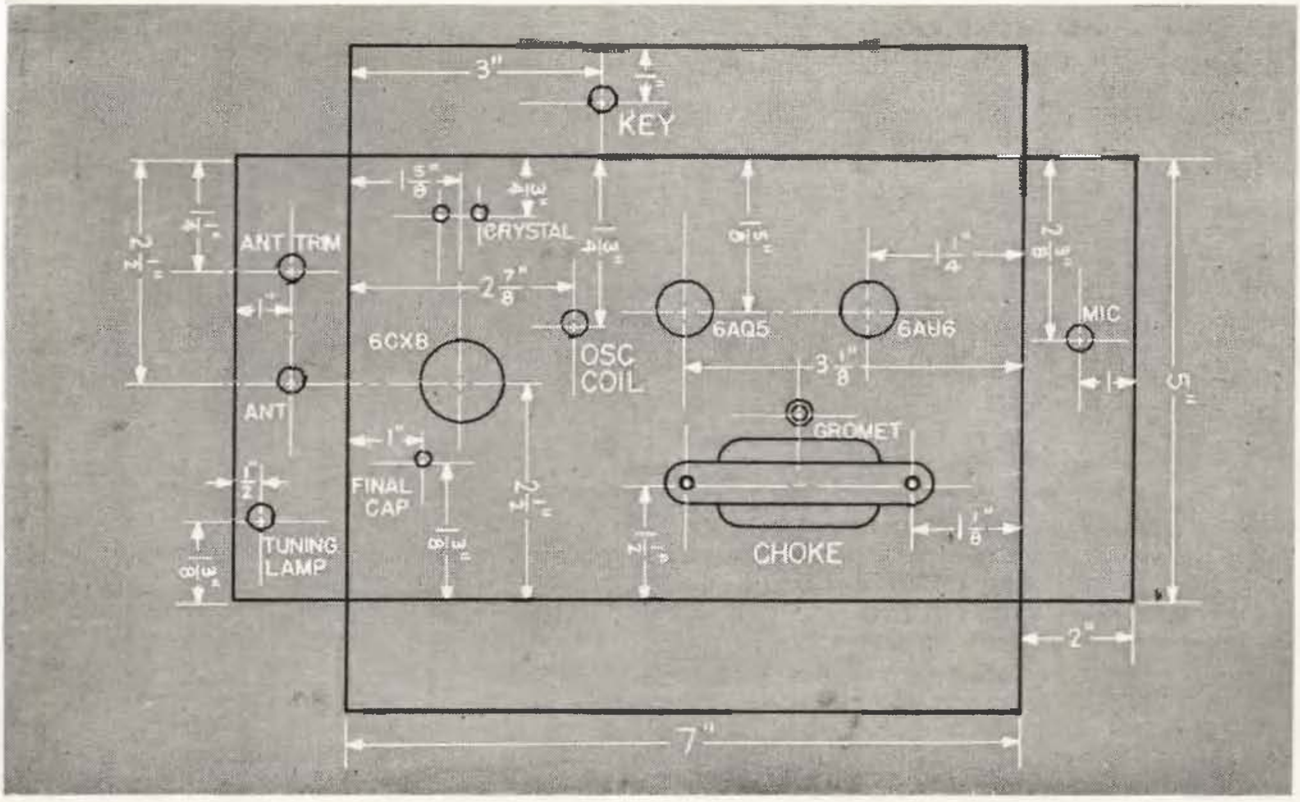
of a B&W #3007 or Air Dux 516T coil (⅝" diameter, 16 turns to the inch, #16 wire). The antenna coupler is one turn of solid hook-up wire.

Since there will be fairly high voltage on the choke leads it is prudent to grommetize the feedthrough hole.

Power Supply. Surely you must have something around that will give 200-250 vdc @ 90 ma. With 250 v you will have an input of 5 watts (20 ma) to the PA section of the 6CX8. This may go up to 25 ma with modulation.

Tuning is easy. You can always build in several dollars worth of panel meters, but you get the same end results by making a #49 pilot lamp and soldering it to a ¾" loop of hook-up wire. Hold the loop close to L1 and adjust the slug for maximum brightness. Next hold it near the final coil and tune the final tank and antenna trimmer for maximum brightness. An rf wattmeter or field-strength meter will also tell you all you need to know for tuning.

The rig is designed for a high impedance dynamic mike and will give plenty of punch with most of the inexpensive ones on the market. Ditto crystal mikes. Just about any type of antenna will load up easily. A halo is fine for general ragchewing, a beam is better for DXing. Give the rig a try and join the local gang on six meters, you'll get a lot of fun out of it.



How To Be An Amateur

John W. Campbell W2ZGU

THE good amateur—that is, the amateur who is useful in causing progress in the field he's in—has certain basic characteristics that are the same, no matter what that field may be. He may be an amateur in radio, electronics, chemistry, painting, or anything else; to be useful he must have a certain basic code—the Code of the Amateur.

A Good Amateur is . . .

1. Ignorant.
2. Egocentric.
3. Impractical.
4. Disrespectful of authority.
5. Materialistic, or pragmatic — not idealistic-theoretical.
6. Inconsistent.
7. Illogical.
8. Discontented.
9. Aggressive.
10. Unfair.

Every one of those characteristics, you no doubt noticed, is generally considered anti-social. The Good Amateur *is* anti-social; he's egocentric, and enjoys his own company, his own work, more than the best chit-chat of the cocktail-party group that is, of course, the highest ideal of the extrovert-social type. The Amateur is anti-social, in that he *likes*—actually *enjoys!*—thinking! He actually prefers using his brains to flapping his jaw; he normally thinks *before* opening his mouth. This is, of course, anti-social, because it imposes the necessity of thinking on those around him—which naturally makes them very uncomfortable. They're not used to it.

The Amateur is Ignorant; this is necessary, because he wants to learn—and you can't learn something you already know. The thing that makes an amateur's ignorance so useful, however, is that you can't learn if you already *think* you know, either. The old line about "It ain't all them things you don't know that causes trouble; it's them things you do know that ain't so." The Amateur is ignorant, and escapes that trouble. Throughout history, amateurs have been lousing things up for professionals by doing what everyone who knew anything about the business knew was impossible . . . . until the amateur, who didn't know any better, did it.

Like "Mad Anthony Wayne", during the Revolution—the amateur soldier. He attacked a perfectly impregnable British position. Anyone with military knowledge knew it was impregnable, because there were sheer, 300-foot cliffs protecting it on three sides, making attack from those directions impossible. "Mad Anthony", not knowing any better, lead his men up the Pallisades at night, and cleaned out the British.

The Amateur has to be Egocentric. That is, nobody's going to pay him for all the hard work he does, so he'd better enjoy what he's doing because it pleases *him*. All his work will, 99.99% of the time, yield nothing but discarded materials, and passed time. In the course of ten years, an Amateur may spend $10,000 on his hobby, wind up with $2 worth of junk, and nothing else . . . . except the self-satisfying fun he had doing it.

That, by the way, is one of the ways in which the Amateur is impractical and unfair. Amateurs happily tackle a research project that has one chance in 10,000 of succeeding, spend ten years and $10,000 on it. Obviously, this is economically unsound; no professional research organization would consider so risky a venture; it would be economic suicide. For one thing, the Amateur in question may be a $100,000-a-year executive in a major corporation; he's worth that to his company, because of the extremely high level of judgment he has. That high ability to judge, to select between alternatives, is being applied in his hobby—the $10,000 worth of material he invests in his hobby is nothing compared to the $1,000,000 worth of highly trained judgement he's also investing!

But the Amateur can, of course, charge off all those expenses, all the investment of time, effort, energy and money, to "Entertainment". It's a head-I-win-tails-you-lose set-up; if his research does not yield the desired result—it still yields ten years of fine entertainment.

This is very unfair competition from the viewpoint of the professional, who has to charge all the time, effort, and money invested to "expenses" — he can't call it "entertainment". The Amateur's research project, in other words, can never wind up bankrupt—in the red—a net loss. The fun of doing it, not the result, is the main product; any workable result is, then, pure gravy—a bonus over and above the call of entertainment.

Time and time again in the history of Science, the great break-throughs have been made by amateurs; the great breakthroughs always

will, for all time to come, be made by amateurs. The reason's simple: a true Amateur can tackle a problem with no reasonable hope of success, and not suffer any loss. No professional can do so.

The essence of a breakthrough discovery, however, is that *it could not have been predicted*, on the basis of previously known facts. Pasteur, a chemist, not a biologist or doctor, achieved the great breakthrough in medical-biological science — the discovery of germ disease. It could not have been predicted beforehand. No one could have, a year previously, reasoned that investigation of microscopic life-forms would be the way to solve the problem of disease.

Put it this way: Today, in the race for space, we need something a darned sight better than rockets. Rockets can never be developed to an economically practical method of commercial use of space; chemical-fueled rockets must consume tons of starting fuel for every pound of pay-load put into space. Nuclear, or photon rockets can never be used to take off from Earth—the exhaust from such a rocket motor necessarily has an apalling energy intensity. It would slag down half a county behind it as it thrust itself up into space.

We *must* develop either an anti-gravity device, or a true space-drive—some kind of a device that can sink its claws into the structure of empty space, and climb like a squirrel going up a tree.

No professional will ever achieve such a breakthrough invention; if Dr. Quiddius Q. Quidnunk of the Research & Development division of the Brontosauric Manufacturing Company does turn up as the discoverer—you can bet he did it as a hobby-amateur project, not in his official capactiy as an R&D man for Brontosauric.

The reason's easy to see. Given: We want an anti-gravity device. It's worth $500,000,000 to the company that gets it. With a prize that size dangling, surely it pays to do research on it!

It would indeed . . . . . if someone could suggest someplace to start!

In 1935, Dr. Robert A. Millikan, one of the world's top atomic physicists, said it would be "250 years, at least" before we could release atomic energy. He was wrong by 243 years. What he meant was that as of 1935, no one had the slightest idea where to start looking for the answer! In 1940, they did know where to start; uranium-235 was the starting point. It took only two years to get an engineering device, once that was known.

The Amateur, because it's "entertainment", can start looking for the place-to-start; he doesnt' have to wait for it to be discovered before launching his research.

The great Bell Laboratories had, of course, been looking for some way of amplifying electrical signals for years, before that kid, Lee de Forest came up with the triode vacuum tube. The transcontinental telephone line was impossible until an amplifier was invented. Bell needed one, knew they needed one, and couldn't imagine where to start looking for one, of course.

There's a lot of government-sponsored research being done today; Commissions, Authorities, Departments and Divisions of the government set up boards, committees, and Agencies to assign research projects.

Let's imagine that government-sponsored research had been common throughout the history of the United States, and consider the probability that a government agency would have made the actually-correct assignment. The boards must, of course, act logically, with careful consideration of the opinions of the authorities in the field. Project assignments must be allotted fairly, logically, on the basis of the best available theoretical knowledge.

Would they, then, have assigned:

1. Development of a rapid, long-distance communication technique to a second-rank portrait painter by the name of Sam Morse?
2. Development of a technique for voice communication to an obscure teacher of the deaf in the Boston area, Alex Bell?
3. Development of a heavier-than-air flying machine to a two-man bicycle shop in Ohio?

Other projects would not have been assigned at all, by a committee which, not being amateur, was logical, had respect for authorities in the field, and acted on theoretical grounds. They would never, for instance, have assigned the project of developing an electric lighting system to anybody; it was proven mathematically by top physicists of the time, that such things could never be practical. The reason is one any radio ham can understand:—It was "known" that the maximum energy-transfer in an electrical circuit was achieved when the resistance of the generator equaled the resistance of the load. Therefore, in an electric lighting system, one-half of the energy would be dissipated in the generator, and only half would be available for lighting. This made the maximum possible efficiency 50% — but worse, it meant that, for any sizable electric system, a tremendous amount of heat would be generated in the dynamo. Large machines would be impossible, because they would simply melt themselves into scrap.

It's most certainly true that if modern generators weren't 99% efficient, they would melt themselves into scrap. It's hard enough to get rid of 1% of ten megawatts, or 100 megawatts of heat; if the learned authorities had been properly respected by Edison, he'd have recognized the futility of inventing incandescent

lights.

The Amateur can, of course, expect all kinds of trouble when he *does* achieve something. The Learned Authorities assure him he's a crackpot; not infrequently the said Learned Authorities have the police arrest him to protect the public from his phoney racket. Alexander Graham Bell was arrested for trying to sell stock in his telephone company, I understand. Louis Pasteur threw his future into jeopardy when he first used his anti-rabies treatment on some Russians who had been bitten by rabid wolves. No M.D. would give them the treatment; Pasteur was not an M.D. and risked trial for murder if one of his patients died. (Things are different now; under modern laws, Pasteur would have been jailed for curing the dying patients. Now it's illegal to try to cure someone, successfully or not, unless you're a licensed M.D.)

It's interesting to realize that three of the most famous criminals in history were, technically, amateurs. Jesus, Galileo and George Washington were all, technically, criminals and amateurs. (Jesus defied the theocratic laws of the Jewish government; Galileo taught, without being properly accredited by the orthodoxy of his time, and Washington was, of course, defying the British Crown, as an amateur statesman-general. Meanwhile, Ben Franklin, amateur diplomat, was doing a bang-up job in France, to England's most acute annoyance.)

A considerable amount of aggressive determination is, therefore, a *sine-qua-non* requirement for the Good Amateur. He can expect a battle when he does achieve his goal.

Obviously, he's achieved it illogically. If it could be achieved logically, from the accepted facts, professionals would have beaten him to it. The criminal-amateur must have achieved the goal by some illogical, unfair step. ("Unfair", when looked at closely, means "You did it by a method I didn't consider proper!" Obviously, if the professional had considered the method proper, and had tried it, he'd have beaten the amateur to the punch.)

Go back and check over the ten points that make for the Good Amateur, and you'll see why they are necessary. If he weren't discontented, of course, he wouldn't be trying to do something that "can't be done", or trying to do better a thing that can be done.

But the Good Amateur must be practical in one respect; he must not seek to compete with the professional on any fair, even-steven basis. He must always seek some underhanded, unfair trick. The amateur must not waste his time-effort-money on trying to do what the professional lab can do a thousand times better, faster, and easier. Don't build your own voltmeter . . . unless you want to learn, by actual building, what a voltmeter really is. Then, of course, you're really building your own knowledge-understanding, not a voltmeter. You simply can't wind as perfect a moving coil, or make as precise and perfectly aligned bearings, as a huge production machine-complex can; it's inefficient to try. Don't try to make your own transistors. Don't try to solve any problem that the professional research labs are working on *in the way the pro labs are trying.*

The pro labs are now, just as an example, trying to find a better method of long-distance communication. They've sent up that Echo sateloon reflector; they've investigated troposphere scatter, they've explored single sideband, pulse code modulation, pulse time modulation, a thousand variations. Don't compete; you'd be "fighting fair", and would be sure to lose.

Be unfair; try finding out how telepathy works. Solve that one, and you'll junk all the multi-megabuck projects the pros have invested in. No pro researcher can tackle the problem, because, of course, it's one of those things that you can't tell where to start working.

Legend has it that Alexander cracked the Gordian Knot problem by slashing through the knot with his sword. Now there's an interesting thing about this; any amateur knows that it's a damn sight easier to untangle a snarl of wire that has only two ends than one that's been cut in two and has about 50 ends. The two-ended knot you can, at least, start *here*, and know that, by simply keeping at it, you'll necessarily come out *there*.

Any pro lab can beat you six ways from zero on that sort of problem; they've got electronic computers, large staffs, and megabucks to grind away at the starting end, and follow it through.

The one that stops the pros, though, is the Gordian Knot after Alexander slashed through. It's got 100 ends, none of which can lead to "the" end.

The real fundamental research scientist is a Good Amateur; that's why government research programs simply can't do a decent job of supporting true basic research. To be truly basic research, the project must *not* know where it's going to wind up, it must *not* know how it's going to get there, and must *not* be logically deductible from known factors.

The "tunnel diode" was the result of a Good Amateur type experiment; the result obtained not only could not have been predicted by previous knowledge—previous knowledge specifically predicted that it couldn't happen! Since it is theoretically impossible for electrons to travel at the speed of light, it could be shown that, theoretically, no electronic mechanism can have signal-transit times as short as light-speed would make possible.

Happily thumbing its minisucle nose at theory, the tunnel diode is an electronic device with signal-transit velocity equal to light-speed.

It also violates all proper transistor solid-

state semi-conductor theoretical approaches. To be any good, a solid-state semi-conductor must have very, *very*, VERY little impurity—"doping"—in it. The tunnel diode results from doping the germanium or silicon like crazy. Do the wrong thing—that's what works!

In the early days, the hams got short-wave radio going by doing wrong things like taking the carefully manufactured tubes right out of their carefully cemented on bases, and soldering the leads directly into their circuits.

The real motto of the amateur must be, "Never give a pro an even break! Be unfair!"

To be a Good Amateur, don't compete with the pros—do what no pro would ever think of doing. And be egocentric—whatever project you pick, pick it because you like it, not because somebody says it is your duty. That way, you're playing the heads-I-win-tails-you-lose game; no matter whether your project succeeds or not, you'll have had a hell of a lot of fun! Tackle the absolutely impractical projects—the ones where you'll have no pro competition. And always disregard Authorities; of course they're sure it's impossible. If they weren't they'd have gone after it themselves. A thing can be economically impossible for professional research—and be completely practical for the happy little amateur. Lord knows climbing Mt. Everest is economically impossible in any profit-and-loss sense. What possible financial profit can be made up there?

And the amateur doesn't have to explain *why* his gadget works; to hell with theory! Be pragmatic; simply use it. Show *that* it works, and let the red-hot theoreticians worry about *why* if they want to.

Also, be ready and willing to be completely inconsistent at any moment. If, one day, while working on a new idea for a two-meter half-kilowatt rig, that you've told everybody is going to be a two-meter transmitter, said unit should suddenly start rising off the bench and floating up toward the ceiling—be inconsistent! Say, "I'm building an anti-gravity machine," and if somebody protests that you said it was a radio transmitter—why, point out that it obviously *is* an anti-gravity machine, so, obviously, that's what you were actually building. That's common sense, isn't it? Why should you care that it consumes a full gallon, and peeps out with only 2 watts on 2? It floats, doesn't it?

Always be willing to change your project if something better slugs you along the way. Like George Baekland; he was trying to synthesize some complex organic chemical, when his chemicals in the apparatus clobbered, turned into goo, and finally set into a solid mess. Efforts to clean his apparatus of the stuff proved totally futile; he couldn't dissolve the mess in anything he could find; it just sat there sneering at all his high-power solvents.

Of course, other chemists had had similar sad accidents, and had had to throw away not only their chemicals, but their apparatus as well. Baekland was by no means the first to wind up with a mess that nothing known to chemistry would remove.

Baekland was simply the first to be a Good Amateur about it; he was inconsistent. "I," he decided, "am *not* synthesizing 1, 2-alpha, betaomicron after all. I'm synthesizing something as useful as the fabled Universal Solvent—the Universal Insoluble! Since I can't get rid of the damn stuff . . . there must be somebody that wants a material that stubborn, so I'll sell it." With that inconsistency of approach, things were easy. It was a snap to remove the apparatus from the mass of bakelite—the glass would break, or dissolve in hydrofluoric acid.

Remember, too, that Bell was working to invent the "musical telegraph"—what we now know as carrier-frequency telegraphy—when he got the wrong result. He was a Good Amateur, and immediately decided he was inventing a telephone instead of a musical telegraph

There are lots of patents to be gained by seeing how *bad* a job you can do. The body-capacitance burglar-alarm, for instance, is the worst possible approach to a stable VFO exaggerated and patented. Almost anything that is *extremely* one thing or another has some useful application. Vide Bakelite. Transistors tend to be very temperature-sensitive; they make wonderful high-sensitivity thermometers because of that. The R-C oscillators such as the multivibrator are horribly unstable . . . which makes them wonderfully useful as frequency multipliers and/or dividers. Being inherently unstable, they'll happily lock in with the frequency of any nearby oscillator.

Each of the characteristics I've listed as necessary to the Good Amateur is considered anti-social. Each of them is . . . . in the wrong place, or wrong degree. But be inconsistent about that, too; in the right place, and right degree, each of them is tremendously useful.

I do not, for instance, recommend disrespect of Authorities when they say "The human organism does not normally operate well after being connected to a 2000 volt power supply."

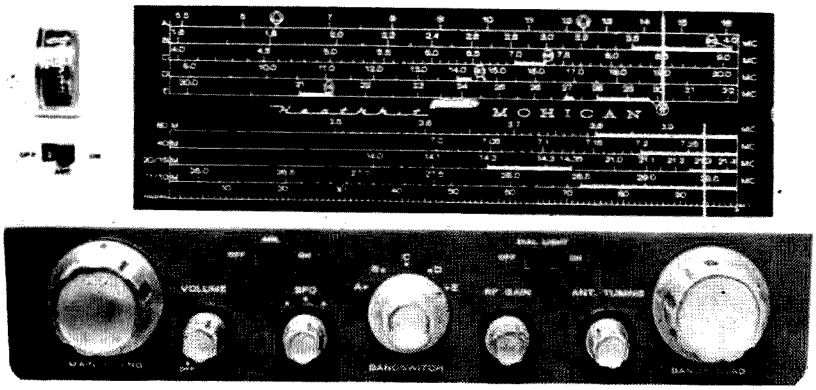
It is also necessary to respect authorities in another sense; they should be respected just as you should respect rattlesnakes, mules' heels, and dynamite. They frequently have power, and should be treated accordingly.

The crackpot is the bird who not only fails to respect authority, but also fails to respect good judgement.

The Good Amateur, of course, fulfills the only useable definition of a Genius: "A Genius is a crackpot who makes money at it."

Naturally . . . . because "makes money at it" is simply another way of saying "has an idea which is economically sound and workable."

Remember that almost any crackpot can *get* a patent; it takes a genius to get one *and sell it!* 73



Testing the Heath Mohican (GC-1A) Transistor Communications Receiver

Donald A. Smith, W3UZN
Associate Editor
P.O. Box 45
Hagerstown, Maryland

PERHAPS you can imagine the doubts which would build up in your mind if you were to take on the job of writing something good about a one hundred dollar "Communications" receiver. Add to this, that it is transistorized and you've had sour experiences with previously available amateur transistor gear.

After the receiver had been assembled (Heath sells *kits*, you know), which took me about 30 hours, the receiver was ready for alignment. I followed the rather complete and thorough instructions provided. Alignment requires a signal generator (like the Heath SG-7) and a VTVM (like the Heath V-7a). Once aligned, I antenna'd it with the whip which comes with the kit and started tuning to determine the magnitude of the disaster.

HMMM, Well, what do you know? HMMM. HMMMMMMMMM! Well I'll be darned! By George! Hey! This thing is really something. The advertised specs of 2 microvolts sensitivity (except on the broadcast band), were found to be quite conservative, even on the ten meter band where most receivers are strangely quiet. This little box of parts held its own right alongside of receivers costing up to twice as much. Let's see what makes it tick.

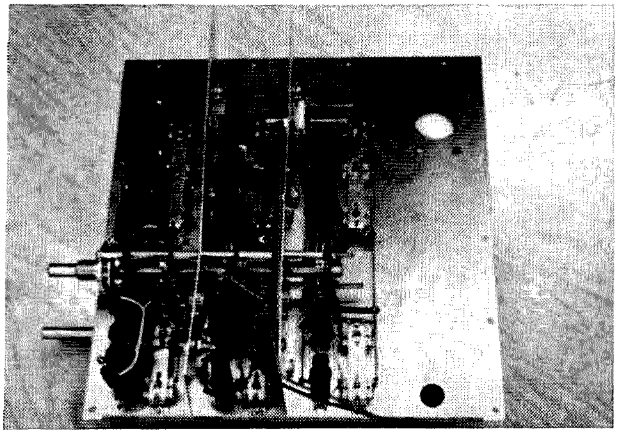
The biggest secret is probably in the front end. After all, if it doesn't have it up front, it doesn't have it. Three transistors are used in the front end. One for rf amplifier, one each for oscillator and mixer. These transistors are not run of the mill jobs, but are good at frequencies up to 100 mc! Thus it's not much of a problem getting performance up to 30 mc. The way the front end layout was designed helps to keep leads short. The transistors are mounted on shields and the band change switch is installed through these shields.

By using adjustable coils in the front end, plus trimmer capacitors, fairly constant sensitivity across the dial is obtained. This eliminates the "dead spots" that we all have experienced.

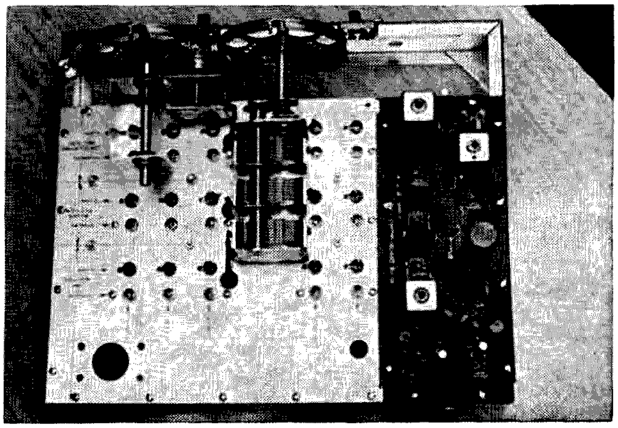
What about selectivity? The figures are 3 kc to the half power point (6 db down), which is made possible by the use of "transfilters". These little jobs are unusual in that they do the job of an if transformer, crystal filter and coupling capacitor, but are none of these. They are somewhat similar to a crystal lattice filter in their operation, though not as efficient. They give much better selectivity than could be achieved from standard if transformers, are rugged and never need adjustment! (Though they have been used by the Signal Corps, this is the first commercial application of them).

What's the line up? 10 transistors, 3 germanium diodes, 2 compensating diodes and 1 voltage regulating Zener diode are used. This gives an rf stage, a separate oscillator and mixer, three if stages, a diode detector, an audio driver and a push-pull output stage. A separate transistor is used for the variable BFO. Diodes are used for automatic noise limiter and AVC.

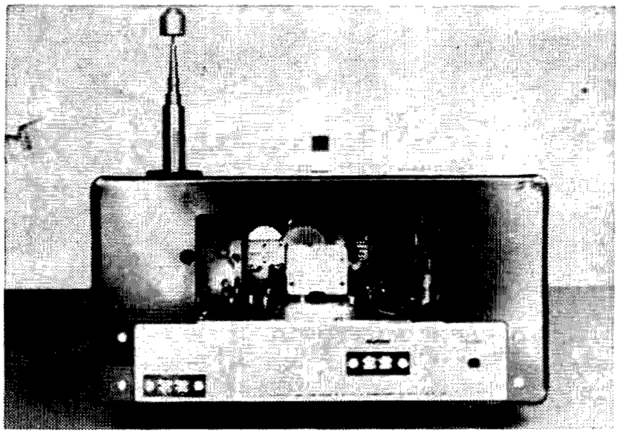
And that's not all! A Zener diode is used



The *rf* section is constructed first. Note that all parts are mounted on a flat sheet, simplifying construction.

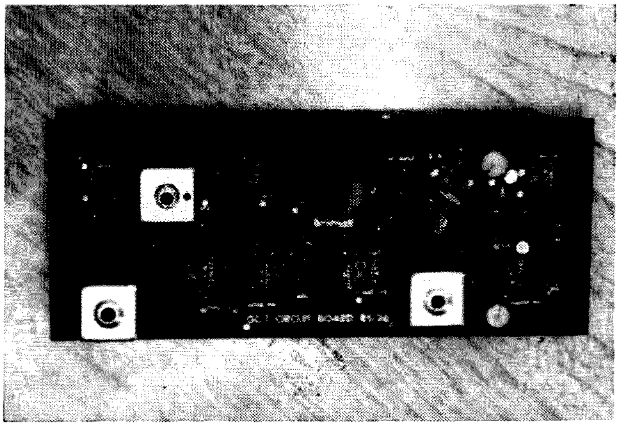


The completed *rf* section and the printed circuit board are mounted on the main chassis and wired to each other.

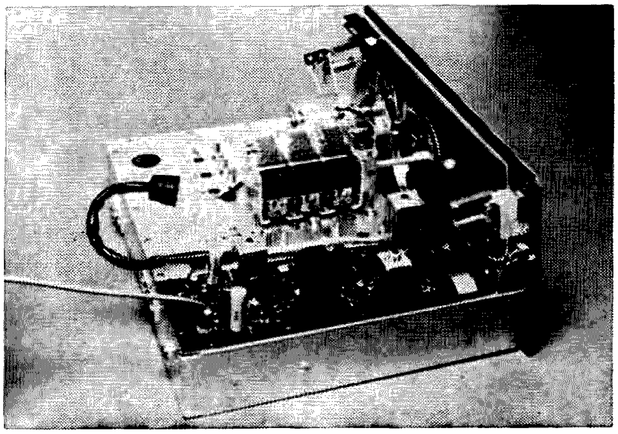


Rear of completed receiver with power supply removed. Plug shown in the cut-out, is power plug which is plugged into power supply.

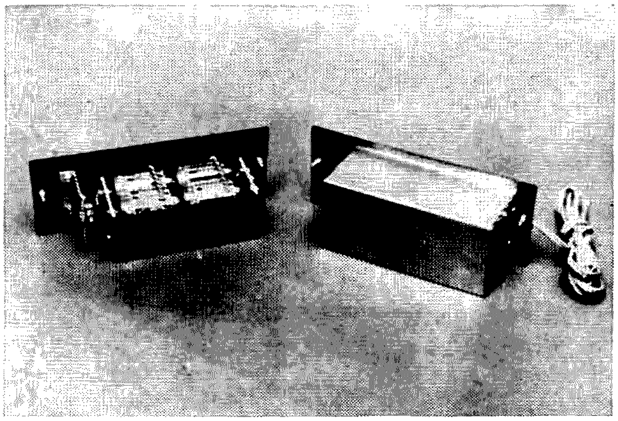
as a voltage regulator for the local oscillator. -6.8 volts is applied from the diode to the transistor oscillator base, holding drift down to a *very* low amount. It is the nature of a Zener diode that when a voltage is applied to the diode backwards, reverse current is very low. If the voltage should exceed this amount, the breakdown potential of the diode occurs



A printed circuit board is used for mounting and wiring of the *if* and audio sections of the receiver.



Completed receiver, cabinet removed. Wire going off to the left connects to speaker mounted in cabinet. Large hole in upper left corner is where "Whip" antenna goes.



Battery supply on left is furnished with the kit, (less batteries). The supply on the right is *ac* operated supply which is purchased separately, if desired.

and the reverse current through the diode increases, bring the voltage back down to the pre-set amount, which is -6.8v in our case.

Another interesting circuit is in the push-pull audio output stage. Two 1N2326 compensating diodes are used, one in each of the output stages, connected to the transistor base circuits. These diodes have a negative tem-

perature coefficient so that as the transistors increase in temperature (as class B transistor output stages do) the diodes will compensate for this increase. By so doing, excessive battery drain is prevented and audio quality is maintained.

These same two diodes also act like voltage regulators, which is important for battery life. As the batteries begin to fall off, they compensate for it (within certain limits, of course). Perhaps you have noticed how the audio becomes distorted as soon as the battery voltage begins to decrease a little in your transistor portable.

By using a push-pull class B output stage more than enough audio is available. A 35 ohm (low impedance) phone jack is provided on the rear of the receiver chassis. The volume is considerably lower if high impedance earphones are used.

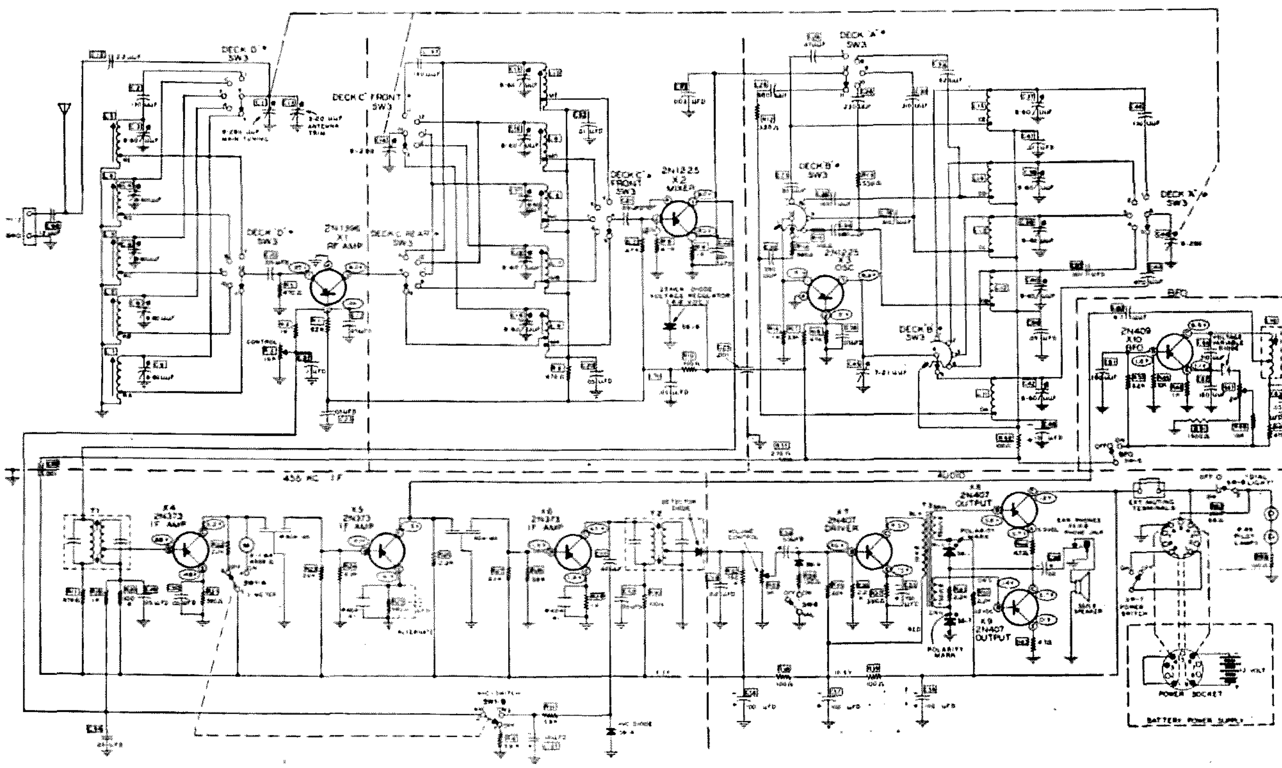
Ordinary flashlight batteries of the "C" size are used and they last up to 400 hours! Replacement costs you less than one dollar. Not bad eh? If you intend using the receiver mostly for shack operation an ac power supply is available for $9.95 which fits in the space provided for the battery case.

Mechanical Aspects

Steel construction gives excellent mechanical and electrical stability. The front end is built on a single sheet of steel, simplifying to some extent this important part of the receiver. The coils, trimmers, band-switch, shields and transistors are built on this plate as a separate section. Steel is also used for the main chassis and the cabinet.

The tuning capacitors (both the bandspread and main tuning capacitors), have anti-backlash gears which are quite effective in providing good vernier tuning. The bandspread, by the way, is good.

Construction begins with the assembling of the front end and the printed circuit board which contains the if stages, audio noise limiter, and BFO. These two sections are then bolted to the main chassis and interconnected. Tuning capacitors and front panel follow. No difficulty was experienced.



In Use

The GC-1A was tested rather thoroughly using the built-in whip, the regular station antennas, and at beach parties. It pulls 'em in no matter how you use it. After several weeks of constant use I was convinced that it did everything I wanted or expected it to do. The selectivity and sensitivity were fine, it worked well on SSB (though a product detector would be somewhat easier to use, of course), and it was a gem for use with my 6 and 2 meter converters.

The spring loaded pilot lamp switch lets you light up the dials when needed and conserves the batteries for more important uses of the amperes.

A close look at the photos will tell you all about the controls on the receiver. It has about everything you really need, including the S-meter. Quite a bundle for the low price and one you'll have a ball with if you give it a try. 73

(CAPACITY METER from page 23)

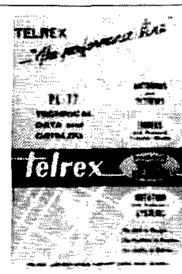
capacitance, the scale is linear and there is no need for other than full-scale calibration. Hence, a variable resistor, R5 in Fig. 1, is used to shunt a bit of extra current around the meter, to allow for battery aging and also to eliminate the necessity of setting the multivibrator exactly on frequency.

By operating the MV at four fixed frequencies, in decades, the range of operation covers practically all small color-coded capacitors. The frequencies used are 100 cycles, 1 kc, 10 kc and 100 kc.

The MV, in Fig. 1, has three possible states of normal operation. They are: Q1 conducting and Q2 cut off, or Q2 on and Q1 cut off, or a transitional state where both conduct. When the power switch, S1, is first turned on either Q1 or Q2 starts to conduct more readily than the other due to inherent circuit unbalance. Due to the regenerative action of the cross coupled amplifiers one or the other soon is driven to saturation, with the opposite amplifier cut off by the large positive bias developed by the charge on the coupling capacitor. The plus charge drains off toward the B— thru the base bias resistor, and at about —0.1 volts of base bias, the cut off transistor then conducts, and regeneration quickly causes this transistor to become saturated, with the opposite one cut off. This process repeats itself at a rate governed mainly by the base bias resistors, R2 and R3 in Fig. 1, and the intercoupling capacitors, C1 thru C8. The result is more or less a square-wave. A capacitor, Cx, is connected across the terminals J1 and J2 with the instrument turned on. When Q1 is conducting and Q2 is cut off, Cx is charged to practically the full battery voltage thru CR1. On the next half cycle Cx discharges thru CR2 and the meter, M1, and recharges again in the opposite polarity, to the supply potential. The result is, of course, a

(Continued on page 50)

New Product



Telrex Catalog

Drop a card to Telrex Labs, Asbury Park, New Jersey and ask for their catalog PL-77. They've listed rather complete data on 100 different ham band antennas that they manufacture, priced from $6.50 for a 10 Meter Mini-Bowtie to $985 for a four band 10-15-20-40 Meter array. And, say, when you're writing, be sure to tell 'em about 73.

Letters to the Editor

Dear Leader:

Just a note to remind you that we retired air marshalls and admirals tending our beds of flowering concubines and scarlet pandemoniums in the Golden Sunset west of the smog bank—uh, where was I? Anyhow don't forget to enter our subscription and bill us when you get that magazine for adult amateurs printed and passed by the post office, the legion of decency and Alexander King. Hope you haven't reneged on the project, Wayne, there's so much good hard work to be done. Meanwhile, hang onto the boat and let the water support most of your weight.

Ken Cole W7IDF
Vashon, Washington

To: Herr Wayne Green

Dear Wayne:

What Hoppen? Here I sit, patiently waiting for the appearance of "73". Put me on the list to start with Vol. 1, No. 1. I will take any long-term subs deal you come up with, assuming that your original figures of $3 a year, five for two years, etc. Five years for ten bucks? I'll take it. How about a "Lifetime" deal for, say, 25 bucks? We both gamble—you bet that I don't live too long and I bet that 73 does. (I am damned well sure that any good technical magazine will survive and make money.) . . .

73 es all that rot,
Fritz Hervey W9IIU
Chilton, Wisconsin

Dear Mr. Green:

Briefly, more power to you.

By keeping the technical level above that of the beginner, but below that of the professional (each of which has his own specialized literature now), the magazine should be a success. A format of technical articles rather than of operating details should have considerable appeal. Might I suggest, however, that you nevertheless have a variety. CW and FSK right through to sideband and antennas. Although I'm not really a desk jockey, it seems to me that intelligent component and equipment manufacturers would be most willing to buy space in the mag. . . .

Jim W5SUC
Ft. Rucker, Alabama

Dear Wayne,

I am very happy to hear about 73 Magazine, and I want to wish you every success. Your proposed editorial policy sounds like just what is needed in a ham radio magazine. I realize that I am probably in the minority, but I don't like to see ham radio becoming so "commercialized." Most beginning hams today seem to be concerned mainly with which factory built equipment to buy. Maybe they shouldn't be blamed for this, after being subjected to a barrage of advertising, but somebody should tell them that this is a technical hobby, and there won't be much justification for our use of the amateur bands if we degenerate into a bunch of "citizen's band broadcasters" who never build any equipment, and have to send the rig back to the factory for repairs. I hope 73 sells plenty of advertising space, but at the same time, if it can steer hams into doing more experimenting and construction work, I'm all for it. Please put me down as a charter subscriber.

I hope I have understood the first paragraph of your letter correctly, with regard to emphasizing technical and construction articles, and will be eagerly awaiting your first issue. I might even whip up a few articles myself for your consideration. Lots of luck!

R. V. McGraw W2LYH

Modulation Fundamentals

Robert W. Schoening, WϕTKX
10040 Brookside Avenue
Minneapolis 20, Minn.

MODULATION systems used by radio amateurs today are increasingly complex. Perhaps in attempting to understand them all, we have neglected the fundamentals. Whatever the reason, the bases of amplitude modulation are widely misunderstood. The same basic theory applies to all the variations of AM, no matter how many sidebands or carriers are transmitted. Here, then, is a review of the AM picture, with a glimpse of the future of radiotelephony.

First, let us define a few terms. *"Splatter"* is a somewhat ambiguous expression, but as used here it means "side-frequencies corresponding to components which are not present at the output of the modulator." Side-freqencies which correspond to audio frequencies which are not in the original intelligence, but are produced somewhere in the audio system of a radiotelephone transmitter, are not necessarily malignant, and will not be termed splatter here.

"Carrier shift" is a disease properly defined as any "change in carrier amplitude during modulation". In spite of widespread misinterpretations, there is a great deal of difference between carrier shift and simple asymmetry of the modulating function. Of course, carrier shift implies nothing with respect to carrier frequency . . . only its amplitude. "Positive carrier shift" is an increase in carrier amplitude during modulation, while "negative carrier shift" is the opposite. A change in carrier amplitude (in voltage or current) is indicated by a change in the *average* voltage or current output of the transmitter when amplitude modulated. Remember that while the rms antenna current (and hence the rms voltage) increases during modulation, and while the peak antenna voltage and current double on 100% positive modulation peaks, the average values should remain constant.

"Downward modulation" is negative carrier shift so severe that the decrease in carrier output is greater than the sideband power produced by modulation. With downward modulation a decrease in total power output occurs when modulation is applied and the antenna ammeter (or neon bulb) kicks down instead of up.

"Radiated modulating power" is a good description of sideband power. The more of this that actually gets to the receiver detector, the greater the volume of sound produced at the loudspeaker. In order to be useful, the audio produced at the receiver should be that which contributes to intelligibility. There are two types of sideband power which do no good: the power contained in sidebands which do not get to the detector due to receiver selectivity; and the power, which, when detected, merely excites the loudspeaker cone without contributing to the intelligibility. For this reason, simply increasing the radiated modulating power is no assurance that the signal will "get out" better. Even a decrease in total sideband power may improve signal reception on a selective receiver at a distant point, if the sideband components remaining are rearranged to do their job properly.

It is important to remember (as if the SSB contingent would allow us to forget) that the carrier's function in AM is only to accommodate the intelligence-bearing components. Leaving sideband power and distribution unchanged and increasing the carrier power will make absolutely no change in the volume at the receiver. Did you ever try this and find that the signal became weaker as you increased the carrier thus decreasing the modulation percentage? If so, you forgot to disable the avc, so that the receiver's gain was reduced as you fed in more carrier. There is some advantage, however, to a strong carrier. The signal will not overmodulate itself so

asily when selective fading is encountered at he receiver, and the heterodynes from adjaent carriers may seem less objectionable. 'here are, in spite of some semi-serious alle·ations to the contrary, absolutely no logical rguments in favor of reducing the carrier unəss the power saved can be utilized in increasng the radiated modulating power, as with SSB.

Methods of extending the positive modulaion peaks do not, as has been suggested, offer nore sideband power without splatter; nor lo they necessarily improve the received sigıal's intelligibility. Any system which produces :arrier shift must produce splatter; moreover splatter may exist without carrier shift.

The normal dc plate input to the final radio 'requency amplifier produces the carrier. For :his reason, carrier shift can occur only if :his dc power changes as the result of moduation, or if the efficiency of the modulated (or linear) amplifier does not behave accordng to the requirements for the type of moduation used. Since dc cannot "get through" a :ransformer, nothing we do in the audio sys:em short of overmodulation can possibly cause :arrier shift. No matter how lop-sided or distorted the modulating waveform becomes in the modulator, it cannot produce splatter as we define it. We automatically rule out defec:ive modulation transformers, autotransformers and choke coupling, of course.

A pure ac wave is one which has an average value of zero because the two alternations enclose exactly equal areas. The two alternations need not be the same shape nor have the same peak amplitude; however if the peak of one alternation goes farther from zero than that of the other, the lower alternation's values stay near their peak longer. When such a waveform is used to modulate a radio frequency wave, the maximum increase and decrease in rf wave amplitude need not be equal, but if the increase (positive modulation peak) is greater, the decrease (negative modulation peak) must last longer. Since the average increase and decrease are then equal, the average amplitude of the rf voltage is unchanged from its unmodulated level—no carrier shift occurs. When we view "modulated envelope" patterns on an oscilloscope, we do not see the individual rf cycles, but only the envelope (whose height is proportional to the peak to peak rf voltage) as it varies in amplitude at some rate corresponding to the modulating function. The top or bottom outline of the envelope corresponds to the actual modulating waveform, whether or not this is the modulator's output waveform. A linear detector receiving the signal will produce an output voltage in this form.

If no modulation is applied, the rf envelope height remains constant as in Fig. 1-A. Fig. 1-B shows the envelope sinusoidally modulated at about 70%, and if nothing unsanitary hap-

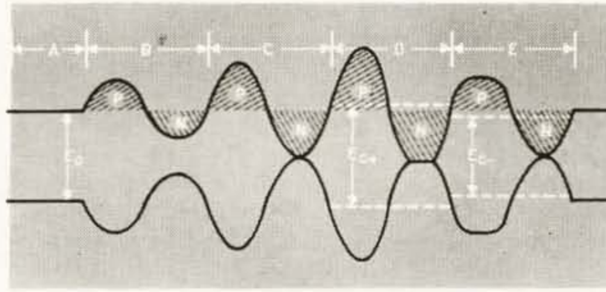


Fig. 1

pens in the process, the positive peaks (P) and the negative peaks (N) will include precisely the same area. The average height of the rf wave envelope is still Ec, just as it was with no modulation.

With a good transmitter, we should be able to increase the amplitude of the modulating signal to obtain 100% modulation (Fig. 1-C) while still maintaining an average amplitude of Ec: no carrier shift.

If the transmitter is capable of extended positive peak modulation (and few really are), a further increase in the modulation gives the pattern of Fig. 1-D. Here the transmitter shuts itself off for a brief portion of the negative peak, so that the positive peaks' areas (P) are greater than those of the negative peaks (N). Now the average rf amplitude increases to Ec+: positive carrier shift. The clipped negative peaks represent a source of vicious splatter. Their sharp corners correspond to modulating frequencies much higher than the actual output of the modulator, and the resulting sidebands are much farther from the carrier than normal. Modulating frequencies this high would not ordinarily be passed by the modulation transformer, so that the broadening will be more severe than that which audio distortion alone could cause.

If the transmitter distorts the positive peaks, splatter may also be produced. In Fig. 1-E the negative peak is the same as 1-C, but the flattened positive peak makes area P less than area N, so that a negative shift in carrier amplitude occurs, and the average rf amplitude becomes Ec—. Actually this flattening is usually more gradual than in 1-D, so the signal may not be quite as broad. It can still clutter up several adjacent channels, however.

Let us consider the causes of condition 1-E. First the flattening did not occur in the audio system, for if it had, the modulation transformer would have automatically made areas P and N equal and no carrier shift could have occurred. The wave might have looked almost the same on the 'scope, but the areas would have been re-distributed symmetrically around the average amplitude, Ec.

With plate modulation, positive modulation peaks occur when the positive audio alternation adds to the dc plate voltage to increase the plate voltage on the modulated rf amplifier stage. During this peak, plate current

should rise in direct proportion, and rf amplifier efficiency should remain constant. Insufficient reserve of cathode emission could prevent a linear increase in plate current. Perhaps the rf amplifier uses a screen grid tube and the screen voltage (which has considerably more effect on plate current than the plate voltage) is not being increased along with the plate voltage. Maybe the tube is running too close to cut-off bias, so that while it remains in class C on negative peaks (reduced plate voltages), it enters class B or even class A as the plate voltage rises. This could produce a drop-off in efficiency on the positive peaks. Remember that "cut-off bias" is proportional to plate voltage, so that an rf amplifier with bias beyond cut-off and 1000 volts on the plate may be running at less than cut-off when the plate voltage doubles as on positive peaks of 100% amplitude modulation.

A very common cause of negative carrier shift in this sort of stage is insufficient rf grid drive. Excitation may suffice for the normal unmodulated plate voltage, but on positive modulation peaks the limit of possible plate current (a function of load impedance and plate voltage) increases, so that more drive is necessary to maintain full plate efficiency during these peaks.

If Fig. 1-E represents the output of a linear rf amplifier or a grid-modulated stage, other causes suggest themselves. In these systems, the rf amplifiers' plate efficiency must approximately double on positive modulation peaks, so if the grid drive is too high, the unmodulated efficiency will run too high and the positive peaks must suffer. Some relief is available here by using a lower plate load impedance to raise the limit of plate current. By juggling drive and loading, we can usually restore the positive peak.

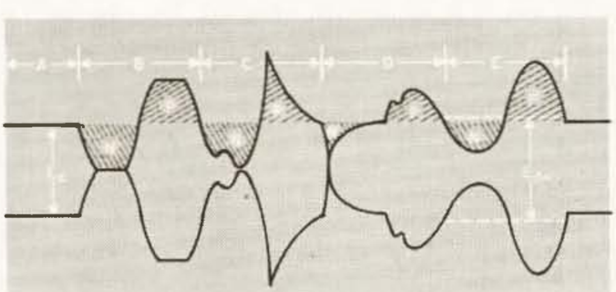


Fig. 2

Figure 2-B shows that two wrongs don't make a right. Here a rare combination of circumstances has resulted in overmodulation without carrier shift, since positive peak flattening exactly matches the negative clipping caused by overmodulation. The average rf amplitude is unchanged from its unmodulated value (Fig. 2-A). Splatter, however, is abundant . . . . the modulator is putting out a sine wave. What if the modulator's output waveform actually was that shown? In that case we would have no splatter by our definition, although the wave would occupy exactly the same spectrum and include the same interference potential. Remember, however, that modulation with this sharp-cornered waveform would be in some special service (hardly telephony unless the modulating frequency is a very low one), and a suitable spectrum assignment would be provided.

Figures 2-C and 2-D show the reasoning behind "extended positive peak" modulation. Voice and music modulation often produces waveforms with unequal peaks. Here a waveform of that type is shown; 100% modulating a radio wave, first in one polarity and then in the other. The drawing is intended to indicate that in both cases the positive peak (P) and the negative peak (N) include the same area. In Fig. 2-C however, the smaller peak is applied negatively, and (assuming again that the transmitter can handle the extended positive peak) modulation in the positive direction can actually exceed 125% without splatter. No carrier shift exists. If, as in Fig. 2-D, the modulating signal is applied in the opposite polarity, the gain control must be backed off, and the sideband power decreased accordingly to prevent negative peak overmodulation, carrier shift, and splatter. The correct polarity for your particular voice may be found by reversing any two wires in the audio system . . . . or even, with some types of microphones, by speaking into the other side of the microphone. The pattern is most easily interpreted for voice modulation if a slow linear sweep (under 100 cycles) is applied to the horizontal plates and the transmitter's rf output sample directly to the vertical plates of the 'scope.

Even if your voice waveform exhibits as much unbalance as in Fig. 2-C, there is a very good possibility that your transmitter cannot handle the extension of positive peaks, for the reasons listed in reference to Fig. 1-E. If you decide to carry the extension farther than can be done by finding the favorable audio polarity, systems have been evolved where a sine wave output from the modulator causes extended positive peak modulation as in Fig. 2-E. We recognize this as carrier shift, and we must admit that it will produce splatter since the modulated wave outline does not conform to the modulator's output waveform. There is a possibility that, if not carried to excess, the spurious side-frequencies produced will not cause serious adjacent channel interference. We have no assurance that the additional sideband power that we attain in this way will not be objectionable, or that it will contribute to intelligibility at the receiver. Systems of this sort which have been suggested in amateur publications do not guarantee against adjacent channel interference even though the negative peaks are not clipped; nor do they put all the extra sideband power through the selective portions of the receiv-

er into the detector. Only by shaping the modulating signal *before* it gets through the modulation transformer, and by carefully distributing its content through the desired audio range can we be sure (assuming a healthy rf amplifier system in the transmitter) that by enhancing the sideband power transmitted, we really improve the signal.

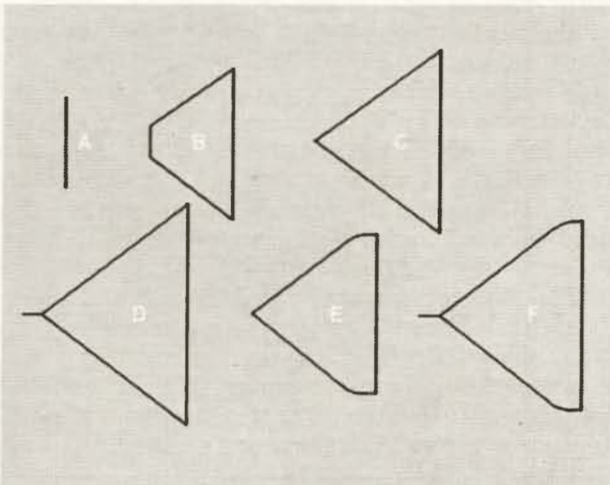


Fig. 3 — 1

Before we make any suggestions, let us review the 'scope patterns by inspecting their corresponding trapezoidal displays. Fig. 3-A, of course, represents the trapezoidal pattern for no modulation. Figs. 3-B, C, D, and E correspond to Figs. 1-B, C, D, and E respectively. Fig. 3-F shows the highly improbable case outlined as a modulated envelope in Fig. 2-B. Drawn to the same scale, Fig. 3-G, in its entirety, is larger (by the cross-hatched area) than 3-C. Due to the greater peak amplitudes obtained with the extended positive peak modulation encountered in the corresponding Fig. 2-C. The shaded triangle of 3-G shows the reduction of positive peaks necessary to prevent overmodulation with improperly polarized audio (2-D). You may have noticed that any bends or corners in the non-parallel sides of our trapezoid represent carrier shift. In 3-D, E, and F, the departures from linearity are abrupt. In 3-H, the bending is gradual, but carrier shift still exists, reflecting the condition (2-E) of artificially extended positive peaks.

Trapezoidal patterns are useful for monitoring voice modulation, but they must be produced correctly to prevent misleading indications. If the audio wave used for horizontal deflection is taken from any point in the audio system other than the secondary of the actual modulation transformer, non-linearities may appear which do not indicate carrier shift. If, on the other hand, the audio deflection is obtained from a detector which rectifies the rf signal, perfect linearity might be indicated even though carrier shift exists. It is often inconvenient or even dangerous, especially with plate modulation, to sample the secondary of the modulation transformer, but this is the only way to get a coherent trapezoid. Readers unfamiliar with these common 'scope displays are advised to look up the connections required in any reference book or handbook covering radiotelephony, and to examine the corresponding patterns shown here, piece by piece, until the relationship is clear.

How can we increase our radiated modulating power without producing side frequencies which are either redundant or unsportsmanlike? It must be done within the audio system, and our old friends clipping and filtering seem to offer the best path for telephone communications. Filtering alone can improve intelligibility by removing lows (long on power which clutters up your audio channel's capabilities, and short on intelligibility). The experts recommend taking out everything below 300 cycles. If this is done, your voice quality will not be appreciably affected, but you will be able to advance the gain control to get more sideband power corresponding to the important audio areas. If you want to go all the way (good for DX but a little extreme for local rag-chewing), attenuate everything below 800 cycles.

Removing the high frequencies above 2500 or 3000 cycles should be done at the last possible point in the audio system; the modulation transformer. This will not, in fact, affect the sound of your voice noticeably—try singing 2500 cycles and see. The components filtered out will be, for the most part, distortion products. If filtering takes place too early, subsequent audio stages may re-introduce high frequency distortion components which while not splatter (by our definition) can cause side-frequencies which your neighbors will resent. Most communications-quality modulation transformers drop off quite well by themselves around 5000 cycles, so "building out" the windings with a bit of shunt capacitance can take care of the highs; especially if low-level filtering is also employed.

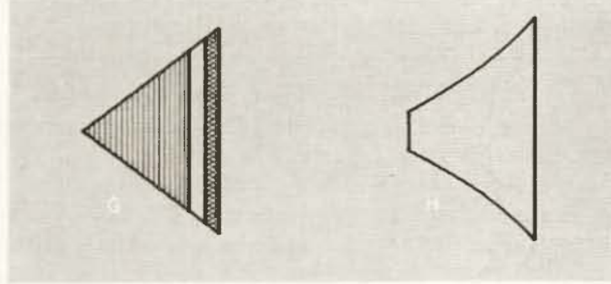


Fig. 3 — 2

Peak-clipping can give tremendous sock to a signal, by increasing average sideband power to a level which would require perhaps ten times as much carrier power were clipping not employed. Volume compression without clipping (as used by broadcasters) can at

(Continued on page 54)

(AUDIO BOOSTER from page 9)

fect balance to begin with, oscillation will develop. Adjust R13, the balance control, until the howls stop. Advance R1 some more, readjusting R13 as necessary, until it becomes impossible to stop oscillations by adjusting R13. This will mark the usable limit of the Booster's gain.

Adjust your transmitter for 100 percent modulation on peaks, using your favorite method of monitoring modulation depth. Then remove the short from the Booster's AGC line and connect it to the microphone input using a Y-type connector. Set the limiting threshold control, R12, at maximum resistance.

Say a few words and check modulation depth. Advance R12 toward minimum resistance until your voice begins to sound like a monotone without inflection[3]. Lock R12 at that position and advance R1 toward minimum resistance until the sound of your voice is satisfactory again. All operating adjustments after initial calibration are made with R1, which can be marked in db. of limiting if desired. At minimum resistance of R1 the Booster is effectively out of the circuit, while at the maximum usable setting compression ratio will be in the neighborhood of 25 db (depending upon your mike).

If you're using a scope to check your modulation, you should at this point be able to see the difference between the modulation percentage with and without the Booster. So far as your effective talk-power is concerned, that gets boosted right along with the modulation index.

The Booster is not limited to AM use, either. It will work with any type of voice modulation, since its only effect on the waveform is to compress the dynamic range. No distortion is generated in the Booster; consequently, no filters or splatter chokes are necessary. 73

[3]At this point, your voice will have long since ceased to sound natural. Our objective in this adjustment is to set the limiting threshold so that the booster completely washes out all amplitude variation in the signal (see note 1). Operating adjustment to regain naturalness in the voice is made with R1.

(POWER SUPPLY from page 27)

A circuit breaker device is used for power supply protection when the supply is used on the 120 volt ac line. If a short should exist in your equipment, loading the supply too heavily, it will cut out, removing the ac supply voltage. To reset it, simply press the bottom on top of the cut-out. On dc operation a fuse is used instead. The circuit layout is not at all critical, though the wires from UHF jacks to the relay should be kept short.

Notice that all outputs from the supply, (filament and B+ voltage, as well as relay), are brought out of the supply through the use of a 6 terminal Jones socket. Terminal #6 is used to control the B+ - Antenna change over relay. If you desire to operate the change over relay from a location other then the chassis of the supply it is only necessary to connect a lead from #6 through a switch to ground. When terminal #6 is grounded, the relay is energized, operating the changeover.

The change-over relay, which is a 6 volt dc type, operates on any of the three input voltages. This is accomplished with a miniature power supply to furnish the proper voltage. Looking at the diagram you will see that a small rectifier, X1, is connected to the 6 volt winding of the power transformer, T1. On 120 volt ac operation, the 6 volts ac is rectified by X1 and filtered into good dc by R2 and C4 for the relay. On 6 and 12 volt dc operation, even though no filament voltages are furnished by the power transformer, X1 and its filter circuit is still receiving 6 volts ac, permitting operation of the relay on all three input voltages.

The power supply shown has been used in both 6 volt and 12 volt cars and in a 12 volt airplane! It has been used extensively on 120 volts ac as well. Neither the vibration of mobile operation, nor the constant changing from one input supply voltage to another has caused any trouble with the unit. 73

(CONVERTERS from page 15)

the mixer coil L3, and then the antenna series capacitor C1 and the cathode coil L1.

After you have aligned the unit you will be amazed by the performance of this inexpensive converter. As simple as it is, it has out-performed many fancy brothers using expensive tubes and many more components.

The noise generator, using a 5722 Sylvania diode, used for evaluation was built and carefully calibrated by the author, using the circuit and method of calibration from the VHF handbook by William I. Orr and H. G. Johnson. The sensitivity tests were made with a Measurements Corporation signal generator Model 80.

Tests performed and evaluated on many typical converters in the frequency range of 220, 144, 108, and 50 mc the averages are as follows:

FREQUENCY	NOISE FIGURE	SENSITIVITY
220 mc	5½ db	.2 µv
144 mc	4½ db	.1 µv
108 mc	4 db	.1 µv
50 mc	3½ db	.1 µv

In conclusion the author wishes to extend his thanks to Joe Kwetnewski W9UTD for his excellent photography. 73

COIL DATA is on page 47 ⟶

CAPACITOR VALUES
FREQUENCIES OF CONVERTERS
(W9DUT CONVERTERS)

C	M.C. 220	M.C. 152	M.C. 144	M.C. 108	M.C. 50	50 M.C. and Lower		
C 1	4-35	4-35	4-35	4-35	4-35	MMF	CERAMIC	TRIMMER
C 2	270	470	470	.001	.001	RMC	TYPE B	
C 3	.001	.001	.01	.01	.01	"	" B	
C 4	270	470	470	.001	.001	"	" B	
C 5	13	15	27	33	50	"	" NPO	
C 6	.001	.001	.001	.01	.01	"	" B	
C 7	.001	.001	.001	.01	.01	"	" B	
C 8	.001	.001	.001	.01	.01	"	" B	
C 9	.001	—	—	—	—			
C10	.005	.005	.01	.01	.02	"	" B	
C11	25	—	—	—	—			
C12	—	25	33	50	50	"	" NPO	
C13	—	470	470	680	.001	"	" B	
C14	—	.005	.01	.01	.02	"	" B	
C15	.001	.001	.001	.001	.001	"	" B	

RC COMBINATION

(R. F. AMPLIFIER)
(CATHODE BIAS)
(AND MIXER BIAS)

R—	68Ω	68Ω	68Ω	68Ω	68Ω		
C—	270	470	470	.001	.001	RMC	TYPE B

RESISTOR VALUES
ALL RESISTOR ½ WATT

COIL DATA

All Coil Forms CTC Slug Tuned

(220 M.C. CONVERTER)

Coil O.D. Inches	Res. Freq. M.C.	No. Turns	Wire Size	Length of Winding	
L1 ¼	220	3	#22	¼"	Space wound (Tap at 1¼T)
L2 "	220	2½	"	¼"	" "
L3 "	220	2	"	3/16"	" "
L4 ⅜	13	45	#30		Close " (2T Link at Cold End)
L5 ¼	207	4	#22	5/16"	Space "
L6 "	34.5	23	#30		Close "
L7 "	103.5	4	#24	5/16"	Space "

(144 M.C. CONVERTER)

Coil O.D. Inches	Res. Freq. M.C.	No. Turns	Wire Size	Length of Winding	
L1 ⅜	144	3½	#22	5/16"	Space wound (Tap at 1¼T)
L2 "	144	3	"	¼"	" "
L3 "	144	4	"	¼"	" "
L4 "	14	40	#30		Close " (2T Link at Cold End)
L5 "	130	4½	#22	¼"	Space "
L6 "	43.+	12	#24		Close "

(152 M.C. CONVERTER)

Coil O.D. Inches	Res. Freq. M.C.	No. Turns	Wire Size	Length of Winding	
L1 ⅜	152	3	#22	¼"	Space wound (Tap at 1T)
L2 "	152	2½	"	¼"	" "
L3 "	152	3	"	¼"	" "
L4 "	13	45	#30		Close " (2T Link at Cold End)
L5 "	139	4	#22	5/16"	Space "
L6 "	46.+	10	#24		Close "

(108 M.C. CONVERTER)

Coil O.D. Inches	Res. Freq. M.C.	No. Turns	Wire Size	Length of Winding	
L1 ⅜	108	6	#22	⅜"	Space wound (Tap at 2T)
L2 "	108	5	"	⅜"	" "
L3 "	108	7	"	⅜"	" "
L4 "	14	40	#30		Close " (2T Link at Cold End)
L5 "	94	6	#24	⅜"	Space "
L6 "	31.+	26	#30		Close "

(50 M.C. CONVERTER)

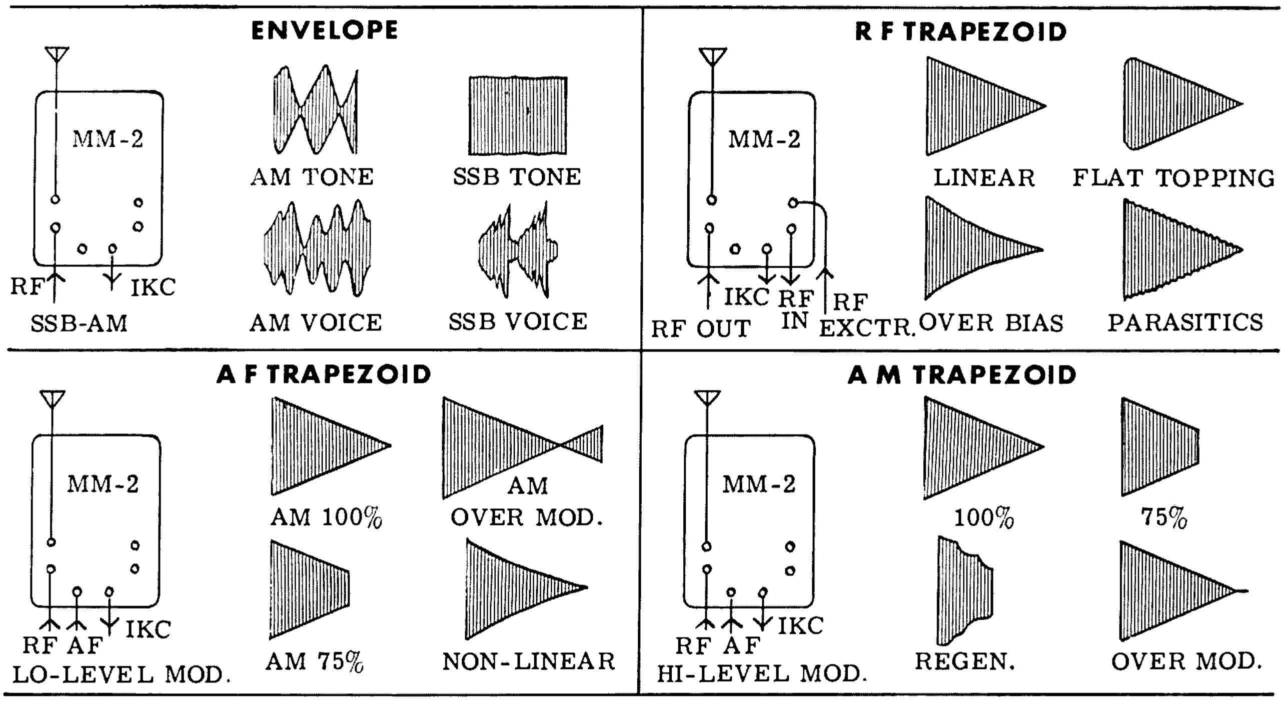
Coil O.D. Inches	Res. Freq. M.C.	No. Turns	Wire Size	Length of Winding	
L1 ⅜	50	10	#24		Close wound (Tap at 3T)
L2 "	50	12	"		" "
L3 "	50	12	"		" "
L4 "	14	40	#30		" " (2T Link at Cold End)
L5 "	36	16	#24		" "
L6 "	36	11	"		" "

THE MULTIPHASE MODEL MM-2
RF ANALYZER

- Monitors the RECEIVED and TRANSMITTED signals. Shows flat-topping, overmodulation, parasitics, keyed wave shape etc. Silent electronic switching keyed by transmitted RF.
- No tuning required. Broadband response flat 1 MC to 55 MC at power levels of 5 watts to 5 KW.
- New variable sweep control for transmit and receive.
- RF attenuator controls height of pattern. Calibrated in 3 DB steps.
- Function selector for ENVELOPE, TRAPEZOID and BOW-TIE patterns on transmit. For SSB, DSB, AM and CW.
- Built-in 1 KC audio oscillator, less than 0.5% distortion. With 3" scope, is ideal for complete alignment of SSB exciters.
- For use in series with 52-72 ohm coax lines. A short pickup antenna may be used with other systems.
- Plug-in adaptors available to match 50 KC, 60 KC, 80 KC or 455 KC receiver IF systems. Only one simple connection to receiver.

MM-2 Kit . . . (less IF adaptor). $119.50
Wired . . . (less IF adaptor). $149.50
Plug-in IF adaptors (wired only) . . . . . .
RM-50 (50 KC), RM-80 (60-80 KC),
RM-455 (450-500 KC). . . ea. . . $12.50

THERE IS NO SUBSTITUTE FOR A SCOPE IF YOU WANT THE CLEANEST, MOST PERFECTLY MODULATED SIGNAL YOUR TRANSMITTER CAN PROVIDE. THE MM-2 IS BY FAR THE MOST DEPENDABLE and EASIEST TO USE, SINCE IT WAS DESIGNED STRICTLY FOR THIS PURPOSE.



OTHER FINE C.E. PRODUCTS

Model 100V	New 100 Watt Broad-Band Exciter-Transmitter . .	$795.00
Model 600L	Broad-Band Linear Amplifier	$495.00
* Model 20A	Bandswitching SSB Exciter	$299.50
* Model 10B	Multiband SSB Exciter	$193.50
* Model GC-1 . . .	Gated-Compression Amplifier	$ 66.50
* Model B	Sideband Slicer with Q Multiplier	$104.50

* Also available in kit form
AND MANY OTHERS . . . WRITE FOR LITERATURE

THE SSB PIONEER

MULTIPHASE EQUIPMENT

Central Electronics, Inc.
1247 W. Belmont Ave. Chicago 13, Illinois
A subsidiary of Zenith Radio Corp.

(CAPACITY METER from page 41)

current indication on the meter, the exact value depending upon the supply voltage, the capacity of Cx, and the rate at which this charge and discharge effect takes place.

In order to protect the meter from damage due to shorted capacitors, CR3, a silicon diode biased in its forward conduction direction, was included. This limits the maximum voltage across the meter to about 0.5 or 0.6 volts. The meter movement itself was thus protected, but spikes due to the capacitor charge caused erroneous readings when the diode conducted prematurely. To prevent this, C13 was included, and in addition C13 provides damping which further prevents meter damage.

In actual use, the range switch is set to a position which gives an on-scale reading. The power switch is then set to CALIBRATE, and R5 is set to give a reading of 100. Then switch back to ON, read the meter, and use the appropriate multiplier indicated on the range switch. Since leaky capacitors would give erroneous indications, a leakage test position was included on the range switch. For this test, Q1 is cut off, Q2 conducting, and the full battery voltage connected across J1 and J2. Any indication of course means a defective capacitor.

Construction

The entire circuit including the battery and a 4½ inch panel meter was built into a 3 x 4 x 5 inch LMB chassis box. Most of the components were mounted on a piece of 1/16 inch epoxy glass board, using eyelets and jumper wires. Use of 100 volt rating capacitors helped cut down the size. The 9 volt mercury battery was mounted in a clip from a cabinet latch. The current drain is in the order of 20 ma, and the required voltage slightly above 6 volts, so a 7.5 or 9.0 volt dry battery could be substituted if desired.

The range switch, S2, should be of the shorting type to prevent the multivibrator from stopping when switching ranges, which would require turning the power switch off, then on again. Aside from the usual precautions to observe polarity of the diodes and battery, the only critical wiring is in the need for short direct leads to J2 from the power switch, and from the power switch, S2, to CR1 and CR2. The capacity of the lead to the standard 100 mmfd capacitor, C12, was about 3 mmfd in the authors instrument, and was allowed for in the selection process. The standard capacitors (C9-10-11-12) were measured on an accurate bridge, and were padded where necessary to obtain the correct value. All other capacitors can be whatever is on hand in the range required, either paper or mylar dielectric type being suitable. For reduction of stray capacity effects a ground from the meter circuit to the case is quite essential. Only type 2N414 and 2N247 transistors have been tried, but similar types should be satisfactory. The silicon diodes recommended for CR3 were the least expensive available, and other types should do as well. Use of decals helps improve the appearance and operating convenience of the unit, but if the meter case is opened, use care to avoid dust or other damage. 73

New York Convention

October 15th

The Hudson Amateur Radio Council is masterminding the first ham radio convention in New York City in well over ten years. While this is billed as a Hudson Division ARRL Convention, it is actually expected to be larger than even the biggest of past National ARRL Conventions.

There will be a full day of technical discussions and forums on just about every amateur specialty and interest (RTTY-SSB-VHF-Antennas-ARRL-YL-CD-MARS-Traffic-DX-etc?). Most of the major manufacturers of ham equipment will be there to explain the details of their latest pride and joy. Prizes? Wow! The whole works will culminate in a banquet with Jean Shepherd K2ORS as Master of Ceremonies and Bill Orr W6SAI as the major speaker.

See you all October 15th, Statler-Hilton Hotel, starting at 9 A.M. 73 will have a booth where you can bring friends and get them to subscribe to 73.

(PHONE PATCH from page 24)

be used. Occasionally during the excitement of hearing from a friend or loved one, the person may blurt out some expression that violates the FCC rules. If this happens, "hit the switch", then firmly but courteously inform him of the regulations regarding such action.

Try not to let the conversation drag. Once in a while a little well timed prompting on your part will eliminate the long and embarrassing pauses that appear when the parties are not used to the "phone patch" system.

Upon conclusion of the patch, again assure the person that there is no charge or obligation involved and that this service is part of the enjoyment that you and your fellow operators get from their hobby.

As to "phone patch" procedure, this may vary between stations. However, the most practical for AM is to have each party say "over" as he finishes talking. This signals each operator to switch from "send" to "receive" without the necessity of signing each time.

Patches should have a reasonable time limitation. If the traffic is of a critical nature and time consuming, don't forget to break for station identification at the proper period of time.

Since the advent of the "phone patch", many operators have been personally involved in dramatic and touching situations. This is especially true of the patches run between members of our Armed Forces and their families at home. From both a technical and service standpoint, each amateur operator should attempt to handle "phone patch" traffic with all the efficiency and courtesy possible. Here again is another chance to benefit humanity through the most fabulous hobby of all—Amateur Radio. 73

(MODULATION from page 45)

least double the radiated modulating power without objectionable distortion. In either case, the modulator will be furnishing more average power than if no limiting were employed, so that extra power-handling capability must be available in the audio system. Normal design limits usually allow your modulator at least 3 db of this reserve without modification.

When clipping is used, filtering must follow to ease the rate of change represented by the flattened audio peaks. When carried to an unusual degree, audio quality becomes less pleasant at first, (who wants to sound pleasant and be buried by QRM?) and then intelligibility begins to suffer. Going beyond this point is useless when the signal is received normally, but there is some indication that a special translation system used at the receiver can reclaim speech waveforms clipped well beyond intelligibility. Perhaps this is a route worth exploring for future applications.

With single-sideband suppressed-carrier radiotelephony, the clipping and filtering tech-

niques are even more rewarding, since the additional radiated modulating power is concentrated in one sideband where most of it must find its way to the detector which will then give even more push to the loudspeaker cone.

What other means might we find to narrow and intensify our radio telephone signals? What about suppressing the audio carrier generated by your vocal chords? Speech, when analyzed, consists of the generation of an audible tone which is amplitude, frequency, and phase modulated, simultaneously, at a syllabic rate. The syllables themselves are subaudio and if only their information were transmitted our radio telephone signals could be as narrow as fast telegraphy. Speech can be re-built around a mechanically-generated tone as is done by persons whose vocal chords do not function. This sort of speech is monotonous, but perfectly readable. The main obstacle with transmitting only the syllabic information and re-inserting the audio tone at the receiver is the loss of un-voiced sounds: the hissing and clicking which contributes to intelligibility, and requires a wider-range audio system than purely syllabic modulation would allow. At any rate, here's a project to consider.

Already with us is the multiple channel AM transmitter which can use a single carrier for several simultaneous communications. Present bandwidth requirements for these systems are quite reasonable. The Kahn AM stereo system for example, occuping no more spectrum than a single dual-sideband station modulating with similar audio frequencies. Broadband systems such as FM broadcasting and television, permit the use of subcarriers (as with FM multiplexing or color television) for a considerable quantity of useful information, and with no increase in bandwidth. Amateurs haven't found much use for these techniques yet. Perhaps some of the ham families could use a single transmitter with channels labelled "his" and "hers".

Let us, first of all, concentrate our intelligence-bearing sidebands into as narrow a band as possible, and put as much power as possible into this band. This should be done before the modulation transformer. The time is here when, even with a single sideband, we must do this to keep pace with the competition. As present techniques become fully exploited, let us thoroughly analyze any new ideas which come along and even develop systems of our own. With present communications speeds in the thousands-of-words-per-minute rate available, it's hard to justify even a six kilocycle bandwidth for simply talking. The CW operator is an artist who does not have to justify his methods on scientific bases. The phone man, however, should have some technical achievements of which he can be proud. Let's get busy: don't wait for the commercial manufacturers to do it!

Technical Broadcasts

The Air Force MARS has a very interesting technical series going every Sunday afternoon. This month the subject is semi-conductors. Time: 2 pm to 4 pm. Tune in and listen. The frequencies are: 3295 kc, 7540 kc, and 15,715 kc.

Oct. 2—Walter S. Miller (Arma Corp.), The Diode
Oct. 9—C. D. Simmons (Philco), Transistor Parameters
Oct. 16—Bud Merrihew (Philco), Transistor Circuits
Oct. 23—John Ekiss (Philco), Tunnel Diode Applications
Oct. 30—Charles Gray (Philco), Transistor Applications

(ELECTRONIC KEY from page 19)

practical *in a single unit.* With the components shown in the circuit diagram, the speed range of the unit is approximately 10 to 25 wpm. Speeds above this range may be obtained simply by changing the component values of the time constant circuits forming the characters. A switching arrangement could be inserted to perform this function, but for simplicity sake it was omitted (and 25 wpm is almost my tops anyway!).

2. When changing speeds, all three potentiometers must be adjusted to obtain the desired speed and weight of keying at the chosen speed. If the controls were ganged, the unit *would not* be as versatile.
3. Potter & Brumfield LM-11 (5K coil) relays are used in my particular unit. However, any high speed plate relay with a high impedance coil should operate satisfactorily. Relays with tail spring adjustments should be used so that additional control of the pull-in and drop-out point of the relays may be obtained when adjusting the key, prior to using it on the air.
4. When all relay adjustments have been completed the adjustments should be locked with a drop of glue.

The unit shown in the photograph is built on a 5"x7"x2" chassis. The cabinet is home brew (aluminum), and was made to fit this particular unit. All connections to this unit are made at the terminal strip bolted to the back of the chassis.

One word of caution: The key terminals are hot (90v dc), so a suitable lucite or plastic shield should be used.

The Key Head

The key head used with an electronic key is essentially a SPDT switch. Recently there have been several of these put on the market. The Vibroplex Company has the Vi-

brokeyer which sells for $15.95 and the Electrophysics Corporation has the Autronic Key for $16.95. Both of these units will work well with this keyer.

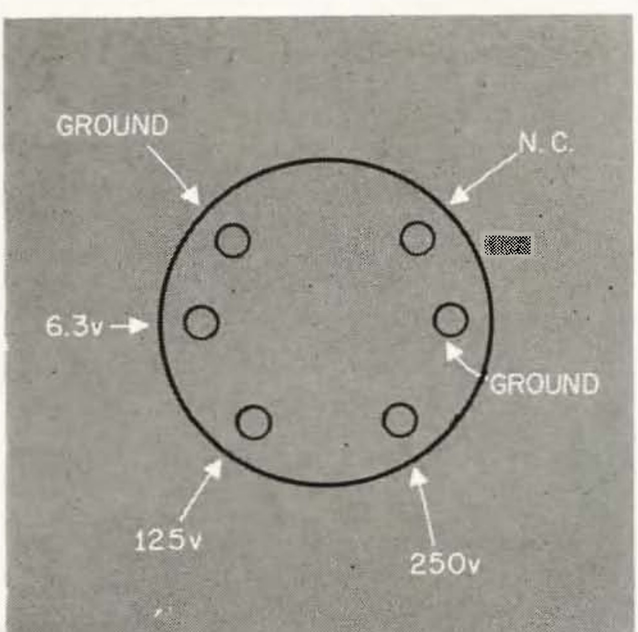
A cheaper solution is to convert your bug. This can be done easily by the addition of an extra terminal. On the bug the dot and dash contacts are connected together. All you have to do to convert for an electronic keyer is run the dot and dash contacts to separate terminals. Connect the dash contact to Terminal #3, the key arm to #4 and the dot contact to #5. This will put 115 vdc between the key base and ground so it is a good idea to make a lucite shield to keep you from being electrocuted.

Adjustment of the key is simple. Move the vibrator weight as far as it will go toward the key handle and tighten the thumb screw. Adjust the dot contact until it just touches the dot contact on the arm. Turn the dot contact screw ¼ turn counter-clockwise. The dot and dash stops should be adjusted to suit your own fist.

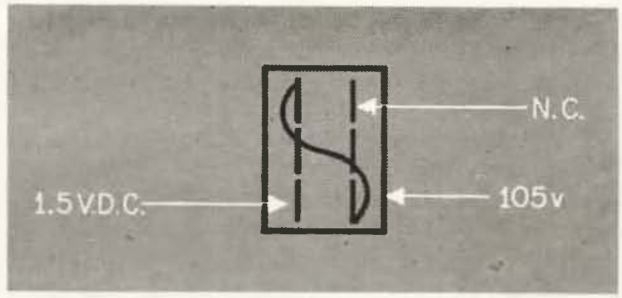
The author has been using this unit for about 5 months now, and the results are gratifying! This unit was also used in the well known 24 hour grind, Field Day, a good test for any piece of gear, and is still going strong! Hope to work you soon with your new Tubeless Electronic Key. 73

(SURPLUS from page 21)

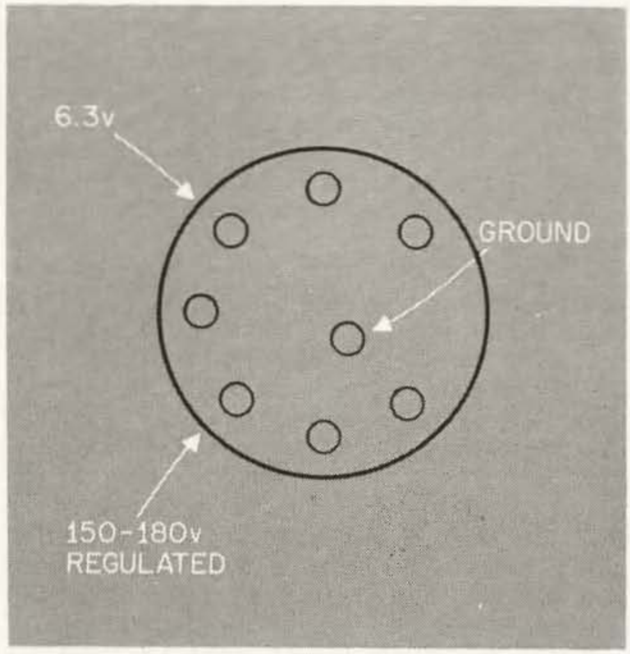
Interested in UHF? Here is a beauty. ASB-5 or CPR-46ACJ. Originally a radar receiver, and following the conversion in Oct. 1956 CQ you will have a gem of a receiver on 420 mc.



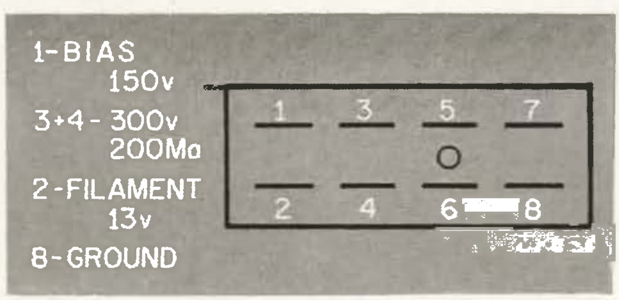
In case anyone is interested in using only the receiver section separated from the complete unit, here are the receiver rear deck connections. Use a Jones plug here.



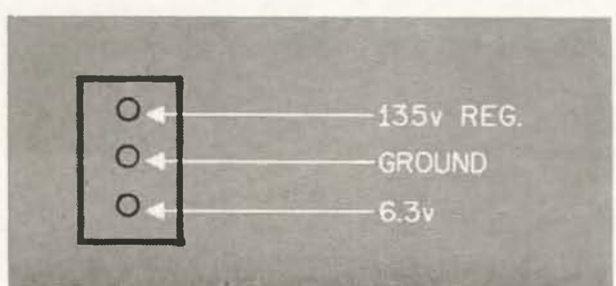
Another UHF band? The R-1/ARR-1 when converted will turn out to be a 220 mc converter with a 50 mc I.F. Complete conversion for this unit can be found back in January 1949 Radio and Television News.



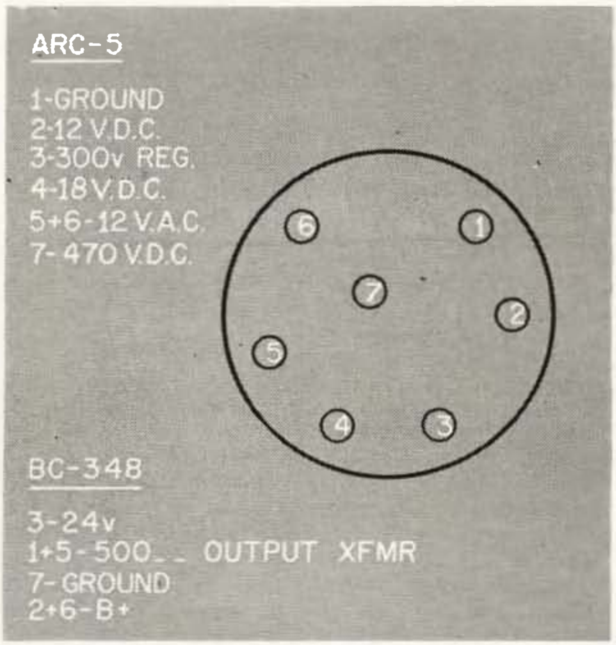
Here is the ever-popular BC-625A (SCR-522). The complete conversion is in July 1947 CQ and information on how to put it on 220 mc is covered in November 1953 CQ.



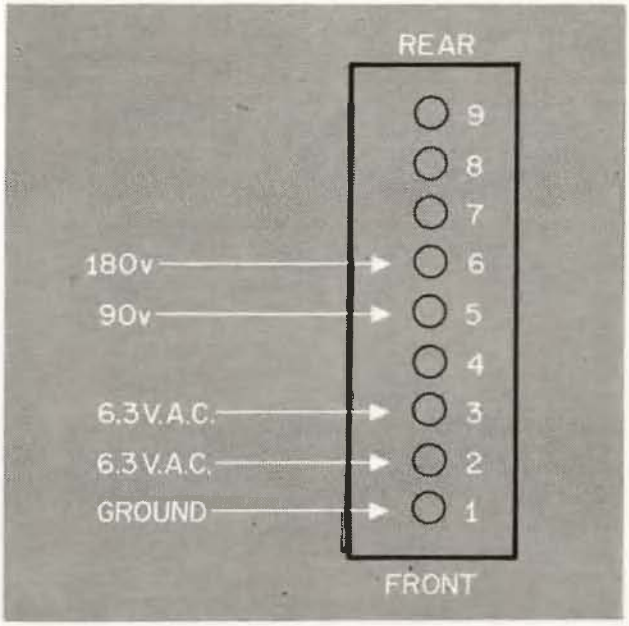
And the well-known BC-221 frequency meter.



Now, the ARC-5 transmitter series. Readily available and capable of fifty watts on cw, a nice unit for the new general. These will operate on 80 and 40, can be converted to work on 20 and one model can be changed to a two or six meter vfo. A wealth of information on the ARC-5 can be found in the CQ publication "C mmand Sets".



And finally, the RAK-7 receiver. This is a low-frequency TRF receiver and has been issued to Army MARS members. You didn't get the manual either, did you?



So, now you have the easy way to do it. The author is not an expert on war surplus, but he has had the units mentioned in operating condition. If you are a newcomer, if you like to experiment and if you like to operate ham radio, investigate the surplus field, it is a lot of fun.

Radio Bookshop

SOME three years ago one of our more obscure amateurs got the notion that since there were specialized nautical bookshops for the yachty gang and sports car bookshops for the adult hot-rodders, that there just might be a need for a radio bookshop for amateurs. After three years of exhaustion providing good service to the few people who answered the monthly ads it became obvious that the idea was a fiasco. Unfortunately he was in too deep by this time. What had started as a few books in the vestibule at home had grown to overwhelming stacks, imported computers, stopwatches, and an amazing variety of goodies.

So, the next time you feel the need for expanding your library, check through this list. A hamshack isn't really complete without a good collection of reference books.

1—ELECTRONICS & RADIO ENGINEERING—Terman. One of the most complete text books ever printed. 1078 pages. Theory, but easy on the math. **$14.50**

2—ELECTRICAL ENGINEERING HANDBOOK—McIlwain. Formulas, tables, circuits. A real handbook. 1618 pages. **$10.00**

5—ANTENNAS—Kraus (W8JK). The most complete book on antennas in print, but largely design and theory, complete with math. **$11.50**

10—1, LIBERTINE—Shepherd (K2ORS). Racy 35¢ book, a best-seller. Specially priced for you at . . . **50¢**

20—RTTY HANDBOOK—Kretzman (W2JTP). A-Z of ham Teletype. Very popular book, low supply. **$3.00**

21—VHF HANDBOOK—Johnson (W6QKI). Types of VHF propagation, VHF circuitry, component limitations, antenna design and construction, test equipment. Very thorough book and one that should be in every VHF shack. **$2.95**

22—BEAM ANTENNA HANDBOOK—Orr (W6SAI). Basics, theory and construction of beams, transmission lines, matching devices, and test equipment. Almost all ham stations need a beam of some sort . . . here is the only source of basic info to help you decide what beam to build or buy, how to install it, how to tune it. **$2.70**

23 — NOVICE & TECHNICIAN HANDBOOK — Stoner (W6TNS). Sugar coated theory: receivers, transmitters, power supplies, antennas; simple construction of a complete station, converting surplus equipment. How to get a ham license, build a station and get on the air. **$2.85**

24—BETTER SHORT WAVE RECEPTION—Orr (W6SAI). How to buy a receiver, how to tune it, align it; building accessories; better antennas; QSL's, maps, aurora zones, CW reception, SSB reception, etc. Handbook for short wave listeners and radio amateurs. **$2.85**

28—TELEVISION INTERFERENCE—Rand (W1D8M). This is the authoritative book on the subject of getting TVI out of your rigs and the neighbors sets. **$1.75**

32—RCA RADIOTRON DESIGNERS HANDBOOK—1500 pages of design notes on every possible type of circuit. Fabulous. Every design engineer needs this one. **$7.50**

40—RADIO HANDBOOK, 15th EDITION—Orr (W6SAI). This is far and away the best amateur radio handbook ever printed. Over 800 pages. **$7.50**

45—CURTA COMPUTER. The world's smallest computer. Send for detailed information. Makes the slide rule look sick. Like a big Monroe computer only hand size. **$125.00**

47 — PRACTICAL ELECTRONICS — Hertzberg (W2DJJ). Almost solid with pictures. Touches lightly on many aspects of electronics: ham radio, TV, transistor radios, hi-fi, microwaves, trouble-shooting, Novice station, antennas, test equipment, etc. **$2.50**

48—BASIC ELECTRONICS—Covers subject completely. Written for use with RCA Institute training course. **$9.25**

49—ELECTRONIC COMMUNICATION—Shrader. Huge book aimed at giving all information necessary for FCC commercial and amateur licenses. **$13.00**

50—MICROMINIATURIZATION—This is the standard text on the subject. Don't see how a company library can be without this one. Everything is going to have to be built smaller, you know. **$11.00**

52—HOW TO READ SCHEMATIC DIAGRAMS—Marks. Components & diagrams; electrical, electronic, ac, dc, audio, rf, TV. Starts with individual circuits and carries through complete equipments. **$3.50**

53—BASIC ELECTRONIC TEST PROCEDURES—Turner. This book covers just about every possible type of electronic test equipment and explains in detail how to use it for every purpose. Testing: audio equipment, receivers, transmitters, transistors, photocels, distortion, tubes, power . . . etc. **$8.00**

54—HAM RADIO HANDBOOK—Hertzberg (W2DJJ). This is a lavishly illustrated book to interest people in the hobby of ham radio. Tells how to get your ticket, select a receiver and transmitter, learn the code. Pictures and info on just about every commercial piece of ham equipment. Better than a catalog. **$2.50**

55—TRANSISTOR CIRCUIT HANDBOOK—Simple, easy to understand explanation of transistor circuits. Dozens of interesting applications. **$4.95**

56 — RADIO TELEPHONE LICENSE MANUAL — Smith (W6BCX). Brand new question and answer study guide for FCC commercial licenses. **$5.00**

57—QUAD ANTENNAS—Orr (W6SAI). Theory, design, construction and operation of cubical quads. Build-it yourself info. Feed systems, tuning. **$2.85**

58—ANTENNAS FOR CITIZENS RADIO—Orr (W6SAI). General coverage, mobile and directional antennas for 27 mc. band. Build & tune 'em. **$1.00**

69—S-9 SIGNALS—Orr (W6SAI). A manual of practical, detailed data covering design and construction of highly efficient, inexpensive antennas for the amateur bands that you can build yourself. **$1.00**

70—CITIZENS RADIO CALL BOOK—Lists all calls issued until January 1960, plus lots of CB info. **$3.95**

71—CITIZENS RADIO CALL BOOK SUPPLEMENT—Calls from January 1960 until July 1960. **$3.95**

72—ABC's OF HAM RADIO—Pyle (W7OE). Designed for the Novice ham. Includes all of the information needed to qualify for the Novice License. 112 pages. **$1.50**

73—101 WAYS TO USE YOUR HAM TEST EQUIPMENT—Middleton. Grid-dip meters, antenna impedance meters, oscilloscopes, bridges, simple noise generators, and reflected power meters are covered. Tells how to chase trouble out of ham gear. 168 pages. **$2.50**

74—HANDBOOK OF ELECTRONIC TABLES & FORMULAS—Formulas & laws, constants, standards, symbols and codes. Math tables, misc. data. **$2.95**

75—BUILD-A-WARD QSL ALBUM—Mount your prize QSL's in this album. Room for 100 cards in each album plus labels for just about all possible operating awards. A fine way to show off your cards. **$1.95**

76—MODERN OSCILLOSCOPES & THEIR USES—Ruiter. Second edition. Shows what a 'scope is, what it does and how to use it for radio, TV, transmitters, etc. 346 pages. **$6.50**

77—BASIC ELECTRICAL MEASUREMENTS—Stout. Second edition. Covers aids to computation, measurement of resistance, galvanometers, shunts, standard cells, potentiometers, alternating current bridges, mutual inductance measurements, bridge accessories, instrument transformers, magnetic measurements . . . and lots more. **$11.65**

78—INTRODUCTION TO ELECTRICAL CIRCUITS—Jackson. Deals with exactly what electronics and electrical engineering technicians need to know. Complete coverage of electrical circuit theory, from beginning level. Develops concepts of current, voltage, resistance, work, and power. Shows how to expand basic concepts to solve elaborate direct and alternating current networks used in modern electrical and electronic circuitry. **$11.65**

79—TRANSISTOR PROJECTS—Skip the theory and start having fun. Radios: self powered, shirt pocket, regenerative, carrier-power, headphone. Instruments and accessories: sine-square wave generator, preamps for VTVM's, gain checker, shortwave calibrator, phase shifter, substitution box. Plus remote transistor ear, electronic compass, simple oscillator, lamp control, multi-impedance amplifier, electronic counter, portable power supply . . . etc. **$2.90**

80—SURPLUS RADIO CONVERSION MANUAL VOLUME NO. I (second edition). This book gives circuit diagrams, photos of most equipment, and rather good and complete conversion instructions for the following: BC-221, BC-342, BC-312, BC-348, BC-412, BC-645, BC-946B, SCR-274N 453A series receivers conversion to 10 meter receivers, SCR-274N 457A series transmitters (conversion to VFO), SCR-522 (BC-624 and BC-625 conversion to 2 meters), TBY to 10 and 6 meters, PE-103A, BC-1068A/1161A receiver to 2 meters, Surplus tube index, cross index of A/N tubes vs. commercial types, TV & FM channels. **$2.50**

81—SURPLUS RADIO CONVERSION MANUAL VOLUME NO. II. Original and conversion circuit diagrams, plus photos of most equipments and full conversion discussion of the following: BC-454/ARC-5 receivers to 10 meters, AN/APS-13 xmtr/rcvr to 420 mc, BC-457/ARC-5 xmtrs to 10 meters, Selenium rectifier power units, ARC-5 power and to include 10 meters, Coil data-simplified VHF, GO-9/TBW, BC-357, TA-12B, AN/ART-13 to ac winding charts, AVT-112A, AM-26/AIC, LM frequency meter, rotators, power chart, ARB diagram. **$2.50**

82—SURPLUS RADIO CONVERSION MANUAL VOLUME NO. III—Original and conversion diagrams, plus some photo of these: 701A, AN/APN-1, AN/CRC-7, AN/URC-4, CBY-29125, 50083, 50141, 52208, 52232, 52302-09, FT-ARA, BC-442, 453-455, 456-459, BC-696, 950, 1066, 1253, 241A for xtal filter, MBF (COL-43065), MD-7/ARC-5, R-9/APN-4, R23-R-28/ARC-5, RAT, RAV, RM-52 (53), Rt-19/ARC-4, SCR-274N, SCR-522, T-15/ARC-5 to T-23/ARC-5, LM, ART-13, BC-312, 342, 348, 191, 375. Schematics of APT-5, ASB-5, BC-659, 1335A, ARR-2, APA10, APT-2. **$2.50**

83—THE SURPLUS HANDBOOK, VOLUME I—Receivers and Transmitters. This book consists entirely of circuit diagrams of surplus equipment and photos of the gear. One of the first things you really have to have to even start considering a conversion of surplus equipment is a good circuit diagram. This book has the following: APN-1, APS-13, ARB, ARC-4, ARC-5, ARC-5 VHF, ARN-5, ARR-2, ASB-7, BC-222, -312, -314, -342, -344, -348, -603, -611, -624 (SCR-522), BC-652, -654, -659, -669, -683, -728, -745, -764, -799, -794, BC-923, -1000, -1004, -1066, -1206, -1306, -1335, BC-AR-231, CRC-7, DAK-3, GF-11, Mark II, MN-26, RAK-5, RAL-5, RAX, Super Pro, TBY, TCS, Resistor Code, Capacitor Color Code, JAN/VT tube index. **$3.00**

84—SURPLUS SCHEMATIC HANDBOOK—This, too, is a book of schematics . . . and just a hint of conversion strategy here and there. Contains: APA38, APN1, APR1, APR2, APS13, ARB, ARC1, ARC3, ARC4, ARC5, ARC5VHF, ARJ, ARK, ATJ, ARN7, ARR2, ART13, ASB7, AS81GR, ATK, BCAR231, AC189, BC-191, 221, 312, 342, 314, 344, 348, 375, 438, 474A, 603, 610, 611, 620, 640, 645, 652, 653, 654, 659, 683, 684, 728, 733, 745, 779, 794, 906, 969, 1000, 1004, 1023, 1206, 1335, BN, BP, C3, F3, CRC7, CRO-208, CRT3, DAE, GF-11, GO9, GRR5, I122, I177, I208, JT350A, LM, MD7, MN26, PRC6, PRS3, R174, RAK, RAL, RAO, RAS, RAX, RBH, RBL, RBM, RBS, RC56, RC57, DC, DR, RDZ, SCR-274, 284, 288, 300, 506, 522, 578, 585, 593, 608, 610, 624, 628, SPR-1, SPR2, TBS99, TEW, TBY, TCK, TCS, TG34, TS34AP, TS251UP, VRC-8-9-10, VVX-1. **$2.50**

85—SO YOU WANT TO BE A HAM—Hertzberg (W2DJJ). Second edition. Good introduction to the hobby. Has photos and brief descriptions of almost every commercially available transmitter and receiver, plus accessories. Lavishly illustrated and readable. **$2.95**

Handy order form for people who don't mind ripping their magazines to pieces.

1	2	5	10	20	21	22	23	24	28	32	40
45	47	48	49	50	52	53	54	55	56	57	58
69	70	71	72	73	74	75	76	77	78	79	80
81	82	83	84	144	145	149	152	153	154	157	161
163	168	169	170	172	173	174	175	177	178	181	185

Circle the book numbers you wish to order. Please include cash, check, money order . . . or something we can deposit in the bank.

Name: .... Call: ....

Address: ....

City: .... Zone: .... State: ....

Radio Bookshop, 1379 East 15th Street, Brooklyn 30, New York

Advertisers Index

Subscriptions

I'VE written quite a few heart-rending subscription ads down through the years. Now I'm faced with my moment of greatest need and I can't think of anything clever to get you to chuckle while you're filling out a check or standing in that long line at the post office to buy a money order. There's no need for me to explain all of the problems that face a new publication. Briefly put, it is this: no circulation means no advertising; no advertising means no money; no money means the publisher takes a long walk on a short pier. So, if you're going to put off subscribing then at least come down and watch my bubbles.

73 is distributed via direct subscription and through some of the more cooperative radio parts distributors. We cannot, at this time, afford to go on the newsstands. This means that word of this new magazine will have to be spread through you, the reader. If you like this first issue and some of the ideas expressed here please tell your friends about the magazine and get them to subscribe. We have some attractive gift cards in case you want to surprise someone who has done something for you.

The first 10,000 subscribers will receive Charter Subscriber cards, giving the date of their original subscription.

73 Subscription: $3.00 one year; $5 two years; $7 three years. DX: Add $1.00 per year.

Send to: 73 Magazine, 1379 East 15th St., Brooklyn 30, N. Y.

Name .... Call ....

Address ....

City .... Zone ... State ....

.... years. Start with issue ....

Name .... Call ....

Address ....

City .... Zone ... State ....

.... years. Start with issue ....

Name .... Call ....

Address ....

City .... Zone ... State ....

.... years. Start with issue ....

Other Ham Publications

ONE of our basic policies, as you will see on page 6, is to encourage the publication of specalized ham bulletins and papers. Here are listed some that we can heartily recommend.

HAM-SWAP. Published by Ham-Swap, Inc., 35 East Wacker Drive, Chicago 1, Illinois. Editor is Ed Shuey, K9BDK. Subs are $1 per year by 3rd class mail, $3 for 1st class, $5 airmail, and $7.20 special delivery. Published twice a month. Contains classified ads entirely. This is your best bet for an inexpensive way to sell or swap some gear in a hurry. Within two weeks people are answering your ad.

FLORIDA RTTY BULLETIN. Fred W. DeMotte W4RWM, P.O. Box 6047, Daytona Beach, Florida. $3 per year including membership in Florida RTTY Society. Mostly operating news with a bit of technical info now and then. All TT men should be getting this.

SOUTHERN CALIFORNIA RTTY BULLETIN. Merrill L. Swan W6AEE, 372 West Warren Way, Arcadia, California. $2.75 per year, not including membership in Society. Operating news and some technical articles. This is the oldest TT bulletin going. All TT men should also get this one. Monthly.

73 HAM CLUB BULLETIN. Marvin Lipton VE3DQX, 311 Rosemary Road, Toronto 10, Ontario, Canada. Sent free to all editors of ham club bulletins monthly to keep them abreast of what is going on with all the other ham clubs. This is an excellent source of news for putting together your club bulletins. To subscribe to this news bulletin just send a copy of your own club bulletin to Marvin.

WESTERN RADIO AMATEUR. Don Williamson W6JRE, 10517 Haverly Street, El Monte, California. Monthly. Subs are $2 per year, $3.50 for two years, $5 for three years. Operating news of west coast activity, columns on DX, SSB, YL, and some articles. 48 pages.

SIDEBANDER. Official organ of the Single Sideband Amateur Radio Association, 12 Elm Street, Lynbrook, L. I., N. Y. Subs include membership to SSBARA: $3 per year. Monthly. Primarily operating news and chitchat for the SSB DX gang. Columns by W8YIN, K5MWU, K6EXT and occasional technical info.

THE MONITOR. Mar-Jax Publishers, 507 West Davis Street, Dallas 8, Texas. $1 a year, 3 years for $2.50. Monthly. Largely operating news. Columns: YL, Club Meetings, Arkansas News, Mississippi News, Florida News, DX, Missouri News, MARS, California News, Louisiana News, VHF News, Oklahoma News, Rio Grande Valley News, Novice News.

VHF AMATEUR. 67 Russell Avenue, Rahway, New Jersey. $2 year, $3.50 two years, $5 three years. Monthly. Operating news for VHF men. Some technical info.

DX-QSL News Letter. Clif Evans, K6BX, Box 385, Bonita, California. Published quarterly. 40¢ each; Annual subscription $1.25 (four copies) by first class mail ($1.50 for DX stations). Lists all QSL Bureaus, managers for rare DX stations, etc.

DIRECTORY OF CERTIFICATES AND AWARDS. Clif Evans, K6BX, Box 385, Bonita, Cal. Complete Directory plus one year of revisions (quarterly) $3.50. Add 50¢ for 1st class mail; $1 for airmail; DX stations 1st class mail add $1.25. Needless to say, this is the most complete collection of data on the hundreds of certificates and awards available.

DX BULLETIN. Don Chesser W4KVX, RFD 1, Burlington, Kentucky. DX news in depth. $5.00 per yr. weekly.

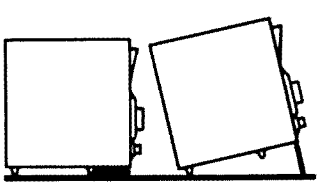
ith built-in PRODUCT DETECTOR

NC 270

THE "COSMIC BLUE" NATIONAL'S NEW HAMBAND RECEIVER

This newest and finest precision double conversion amateur receiver with 6 meter coverage, brings you an ease of sideband tuning previously available only in the most expensive equipment. The NC-270 features an exclusive "Ferrite Filter" for instant upper-lower SSB selection and a degree of selectivity to conquer even the toughest AM and CW signal conditions. The solid 1/8" steel panel, ceramic coil forms, double-spaced tuning gang, and full ventilation cabinet combine to give mechanical and thermal stability that will surprise even the most critical operator. Even the color of the NC-270 is outstandingly different, National's new duo-tone "Cosmic Blue." Write for detailed specifications.

Only $24.99 down*



And National Radio's patented "Flip Foot" makes operating the NC-270 so easy.

Suggested cash price: $249.95. NTS-3 Matching Speaker. $19.95 (slightly higher west of the Rockies and outside the U.S.A.). *Most National distributors offer budget terms and trade-in allowances.

NATIONAL RADIO COMPANY, INC. ®

A WHOLLY OWNED SUBSIDIARY OF NATIONAL CO., INC. **MELROSE 76, MASS.**

Export: AD AURIEMA, INC., 85 Broad St., New York, N. Y.

Canada: CANADIAN MARCONI CO., 830 Bayview Ave., Toronto 17, Ont.

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

November 1960

37¢

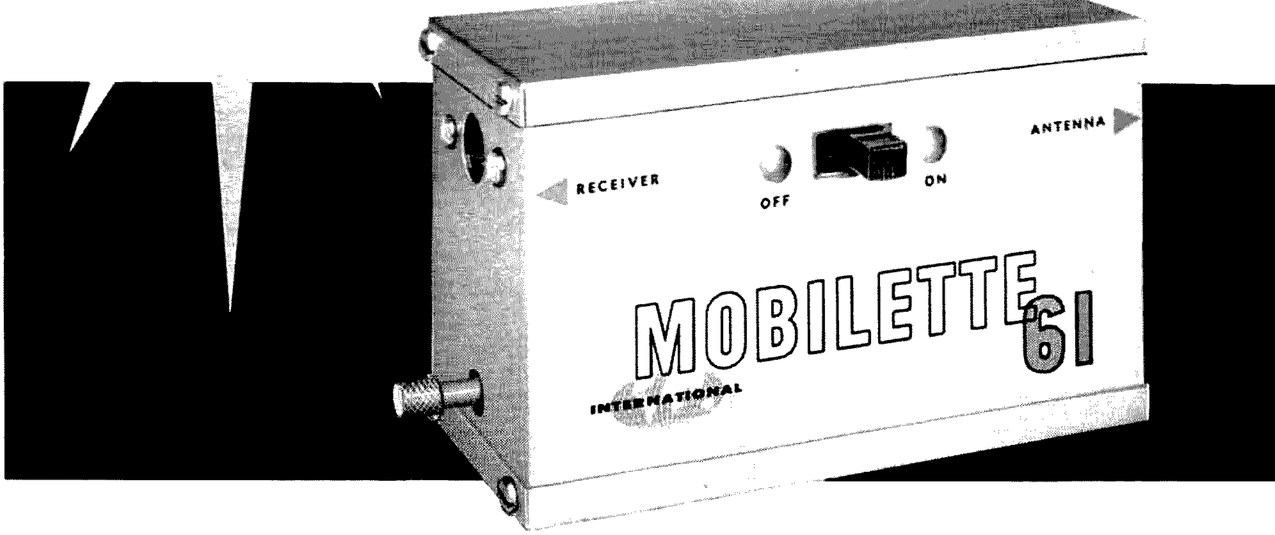
73

Amateur Radio

AMATEURS

CITIZEN LICENCEES

MOBILETTE 61



MOBILETTE 61, International's *new improved* all transistor, crystal controlled converter provides a "quick and easy" way to convert your car radio for short wave reception. MOBILETTE 61, units cover a specific band of frequencies providing a broad tuning range. Mobilette units are miniature size and quickly interchangeable.

Check these all New features . . . New and improved circuit for increased gain . . . New internal jumper for positive and negative grounds . . . New RF amplifier, mixer/oscillator . . . New separate input for broadcast and short wave antennas . . . Mounting bracket for under dash installation.

MOBILETTE 61, is available in a wide choice of frequencies covering the Amateur bands 75 through 6 meters, Citizens band, Civil Air Patrol

CIVIL AIR PATROL

AMATEURS

CITIZEN LICENCEES

. . with improved circuit

for mobile short wave reception

Write for International's complete catalog of precision radio crystals, and quality electronic equipment—yours for the asking.

INTERNATIONAL CRYSTAL MANUFACTURING CO., INC.

18 NORTH LEE • OKLAHOMA CITY, OKLA.

w band frequencies, WWV time and frequency standards. Any frequency the range 2 MC to 50 MC available on special order.*

esigned for 12 VDC, OBILETTE 61 will operate on 6 VDC at reduced itput. Power connector ugs into cigarette lighter cket.

e the **MOBILETTE 61** Your Dealer Today.

Mobilette 61 units cover these short wave frequencies.

Catalog No.	Frequency		
630 - 110	6 meters	(Amateur)	50 - 51 MC
630 - 111	10 meters	(Amateur)	28.5 - 29.5 MC
630 - 112	11 meters	(Citizens)	26.9 - 27.3 MC
630 - 113	15 meters	(Amateur)	21 - 21.6 MC
630 - 114	20 meters	(Amateur)	14 - 14.4 MC
	15 MC	(WWV)	
630 - 115	40 meters	(Amateur)	7 - 7.4 MC
630 - 116	75 meters	(Amateur)	
630 - 117	10 MC	(WWV)	
630 - 118	CAP	(Low Band)	
630 - 119	Special Frequencies		2 MC - 50 MC

omplete, ready to plug in and operate . . . . only $22.95

**Special frequencies 2 MC -50 MC..........only $25.95*

73 Magazine
1379 East 15th Street
Brooklyn 30, N. Y.

November, 1960
Vol. 1, No. 2

Table of Contents

Staff:

editor-publisher .... Wayne Green W2NSD
publications manager .... David Fish
associate editor .... Jim Kyle K5JKX
associate editor .... Don Smith W3UZN
associate editor .... Marvin Lipton VE3DQX
contributing editor .... John Campbell W2ZGU
subscriptions .... Virginia K2MNW

The Cover: In the spotlight this month is the new 6DJ8/ECC88 tube by CBS Electronics, which, when applied to the front end of the Gonset Communicator (page 28), slashes the devil out of the signal-to-noise ratio.

73 (Title registered U. S. Post Office) is published monthly by Amateur Radio Publishing, Inc. Executive and editorial offices at 1379 East 15th Street, Brooklyn 30, New York. Telephone: INgersoll 9-6957.
Application for entry as second-class matter is pending at Norwalk, Conn.
Subscription rates: U. S. A. and possessions, APO, FPO, Canada and Mexico; one year $3.00; two years $5.00; three years $7.00. Foreign: one year $4.00; two years $7.00.

Postmaster: send form 3579 to 73 Magazine, 1379 East 15th Street, Brooklyn 30, New York.

. . . de W2NSD

WELL, here we are with the second inaugural issue of 73. We're only one month old and you're already reading the magazine . . . amazing.

It is probably quite improper for me to take brand new subscribers to task and it may tend to create some apathy when I bring up the subject of your getting friends to subscribe, but still I am duty-bound (as head advertising salesman) to politely remind some readers that they did not send letters of encouragement to all of the advertisers in the first issue. Further, and with even more serious consequences, it seems that a few of the advertisers have not yet experienced the sudden upswing in sales that I may have led them to expect.

Fortunately, as you scan the advertising index of this issue, you will see that the hardier advertisers are willing to let bygones be bygones . . . providing that my over-optimistic promises for this month come closer to fruition. I realize that this is quite a lot of responsibility for you, but possibly you can chalk up the sudden expenses to Christmas or something. I'm sure that your tax consultant will agree with me that it is very poor planning to end up the year with extra money hanging around.

Now, about those subscriptions. Why not flip back to our subscription persuader and write in the names of several of your friends? This, with a small cash (or check) enclosure, will result in twelve equally spaced reminders of your kindness and generosity. We will also leave room for you to be generous to yourself, where it will certainly be most appreciated.

Feedback

We both have a vested interest in 73 being as interesting as possible. You can help me keep my finger on your pulse by sending a postcard every month listing the articles in the order of your interest. I will publish results of this monthly survey as an encouragement to the authors. The top author each month will get, in addition to the compliment, a check from us for 50% of his original payment. Thus your vote each month will serve to help me in the selection of future articles and will encourage good writers both with plaudits and some extra cash!
—W2NSD

Moonbounce Article

Among the items listed as tentative for our first issue of 73 was a feature article on the Moonbounce Project of W1FZJ. This, as you may possibly have noticed failed to come off as scheduled.

When I got word from Sam, W1FZJ, that the contact had finally been made I quickly drove up to his antenna farm just outside Boston and took some pictures of his latest antenna monstrosities. I figured that the event would be covered in the other ham magazines in September and that there was little point in rehashing it in 73 in October. After talking with Sam for awhile it was obvious that there were a lot of interesting things which had been overlooked by the previous interviewers. I suggested that he reduce these to written form to go with my pictures.

Thirty-two phone calls later, with the last minute deadline for issue #1 at hand, it became obvious that Sam wasn't going to be able to make it.

We've got some promises on other 1296 mc Mechanno that should be intriguing. Are you interested?

Cash

Everywhere I go people want to know what sort of articles we're looking for. My yardstick is simple: if the article is interesting and accurate I want to print it. I have found dozens and dozens of interesting pieces of equipment that should be written up. Haven't you designed something unusual which your friends have been asking about? Drop a card for our style sheet and get to it.

Your Money's Worth

An independent survey (by me) of the actual number of pages devoted to ham articles in the October issues of various ham publications was quite revealing.

73 Magazine	**46 pages**
Brand X	**37 pages**
Brand Y	**26 pages**

In looking over the feedback cards it is interesting to note that the John Campbell article, "How to be an Amateur", is, on most cards, either listed first or not listed at all. The obvious conclusion is that the prosaic title allowed many readers to miss this gem. By a strange and gratifying circumstance a feature article on John Campbell appeared in the October 8th issue of the Saturday Evening Post. The Post article was very interesting, and I suggest that you dig back and look it up. Ditto our article if you missed it. The final announcement of the feedback results of issue #1 will be made next month. If you haven't voted yet, hop to it.

Moon Trim

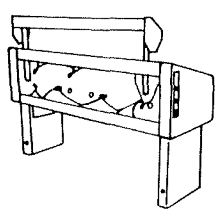
Sam Harris W1FZJ, chances debeardization at the business end of the Rube Goldberg contraption set up to cut the tape to open the Hudson Division Convention. I'm a little confused about the setup, but it went something like this: a signal was to be sent from W1FZJ on 1296 mc via the moon to W8LIO out in Dorset, Ohio. From there what was left of the impulse was to be sent to K2MGE out on Long Island. It was then to be relayed to a waiting receiver on top of the Statler-Hilton Hotel in Manhattan and down to the Convention Floor where it would be used to operate solenoid driven shears.

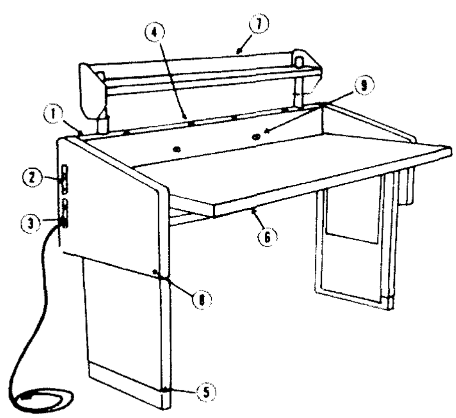
The shears were snapping angrily at anyone who dared to near them when I looked in on the setup the night before the Convention, being energized by random noises reaching the receiver. I missed the Big Event the next morning, but it obviously must have come off because eager amateurs began pouring into the exhibit area at 9 A.M. and queuing up for subscriptions to 73. Note "73" button on Sam.

Sam Harris, W1FZJ

NEW! A PRE-ENGINEERED HAM EQUIPMENT CENTER WITH BUILT-IN POWER & COMMUNICATION FACILITIES

Bring the ham center up out of the cellar—let the whole family share in the fascinating world opened up by global communications. The handsome styling of this functional unit fits well in any decor—neatly organizes equipment and cables.





DELUXE STATION FACILITY . . . complete with formica top, vinyl trimmed ends, shelf and all electrical and mechanical features listed above. Approx. shipping weight 190 lbs. F.O.B. BROCKTON, MASS.
Part number 5203-2DSFA AMATEUR NET only $139.95.

STANDARD STATION FACILITY OR WORK BENCH . . . complete with standard steel ends, masonite top, and all applicable features as described above. Approx. shipping weight 160 lbs. F.O.B. BROCKTON, MASS.
Part number 5203-2SSFA AMATEUR NET only $99.95.

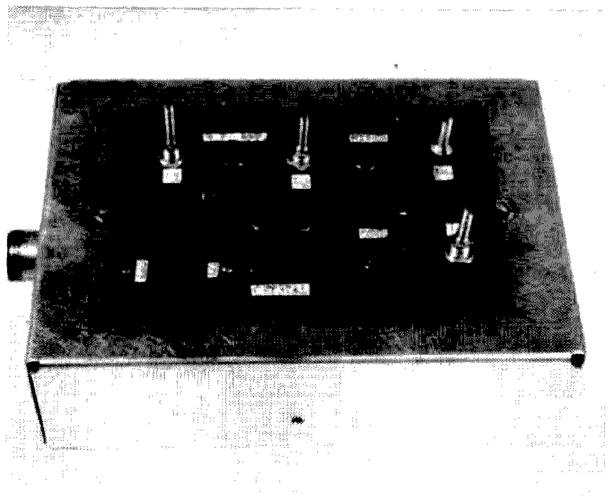
Order direct from factory or write to customer department for additional information.

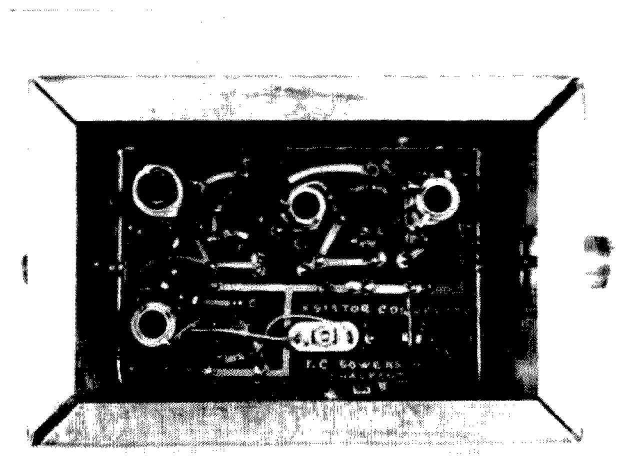
ALDEN PRODUCTS COMPANY
BROCKTON, MASS.

OUTSTANDING FEATURES—

1. UNIQUE power channel safely encloses all inter connecting wiring, relays, etc. Eliminates "rat's nest" behind equipment. Room for built-in powe supply, filter network, etc.
2. CONVENIENT "big switch" with indicating fus holder and neon pilot light—additional individu ally controlled and fused circuit switches may b added.
3. THREE wire detachable line cord brings in a power—insures proper grounding.
4. POWER channel has eight 110-volt outlets— above top and 4 below top—with grounding conta —eliminates makeshift outlet strips or adapter
5. COMFORTABLE operating position—legs are a justable to suit your individual needs—caste may be added for portability.
6. MASSIVE 1¾" thick top 26" x 60" provides amp room for transmitter, receiver, VFO, amplifier, et Deluxe top is white formica—standard is masonit
7. ADJUSTABLE shelf, standard on deluxe mode holds test, monitoring or other equipment co venient to operator.
8. END panel covers removable—provide addition storage area for tools, tubes, etc.
9. DELUXE model equipped with 3 SO-239 RF a tenna lead connectors.
10. EASILY assembled with ½" wrench and scre driver—all screws removable with coin.
11. PLEASING appearance will appeal to XYL. D luxe—two tone gray—gleaming white formica t —vinyl trimmed ends. Standard—gray with brow masonite top.
12. HEAVY gauge bonderized steel construction wi baked enamel finish will last a lifetime.

Additional accessories will be available soon—watch for advertisement. Specs. and prices subject to change without noti





Thomas C. Sowers W3BUL
47 Bethlehem Pike
Colmar, Pennsylvania

Transistor Printed Circuit 10 Meter Converter

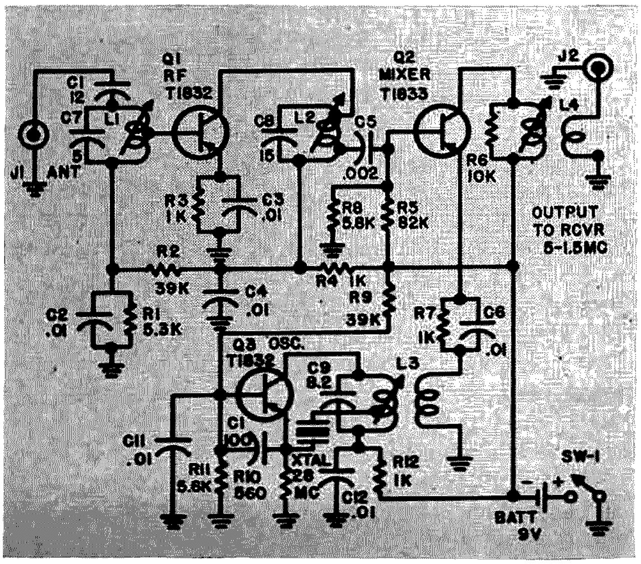
RADIO amateurs who have hesitated going mobile because of the necessity of making iternal connections to the auto radio will find iis x-sistor converter the answer to their long-waited dreams. It is also adaptable to the idio of the newer cars having the 12 volt bat-ry system. The only necessary connection to the auto radio is through the antenna, and this is simply a matter of plugging the antenna into the converter and running a short piece of coaxial cable to the antenna jack of the radio. The normal auto antenna may be used satisfactorily if it is extended to its full length, but a mobile whip of the proper length will

PARTS LIST

V-1—SPST Slide Switch
—Amphenol SO-239 coaxial connector
—(RCA Type) Phono Connector
itt. 9V Mallory No. TR-146R
ansistor Sockets (3) ELCO 3301
al—28 mc (overtone)

COIL DATA

—18 turns, #26 E. wire tapped at 3 turns from bottom end.
—18 turns, #26 E. wire tapped at 3 turns and 9 turns from bottom end.
—18 turns. #26 E. wire tapped at 3 turns from bottom end. The secondary is one turn of #26 E. wire over the primary with a piece of plastic tape between.
—Vari-Loopstick Lafayette MS-11 or equivalent. The secondary is 48 turns of #26 E. wire scramble wound over the primary with a piece of plastic tape between.
, L2 and L3 are wound on Cambridge Iron slug-tuned LS5 coil forms. Space wind the coils to cover one inch for wide tuning range.
Capacitors C7, C8 and C9 may have to be altered slightly for the 15 meter band.



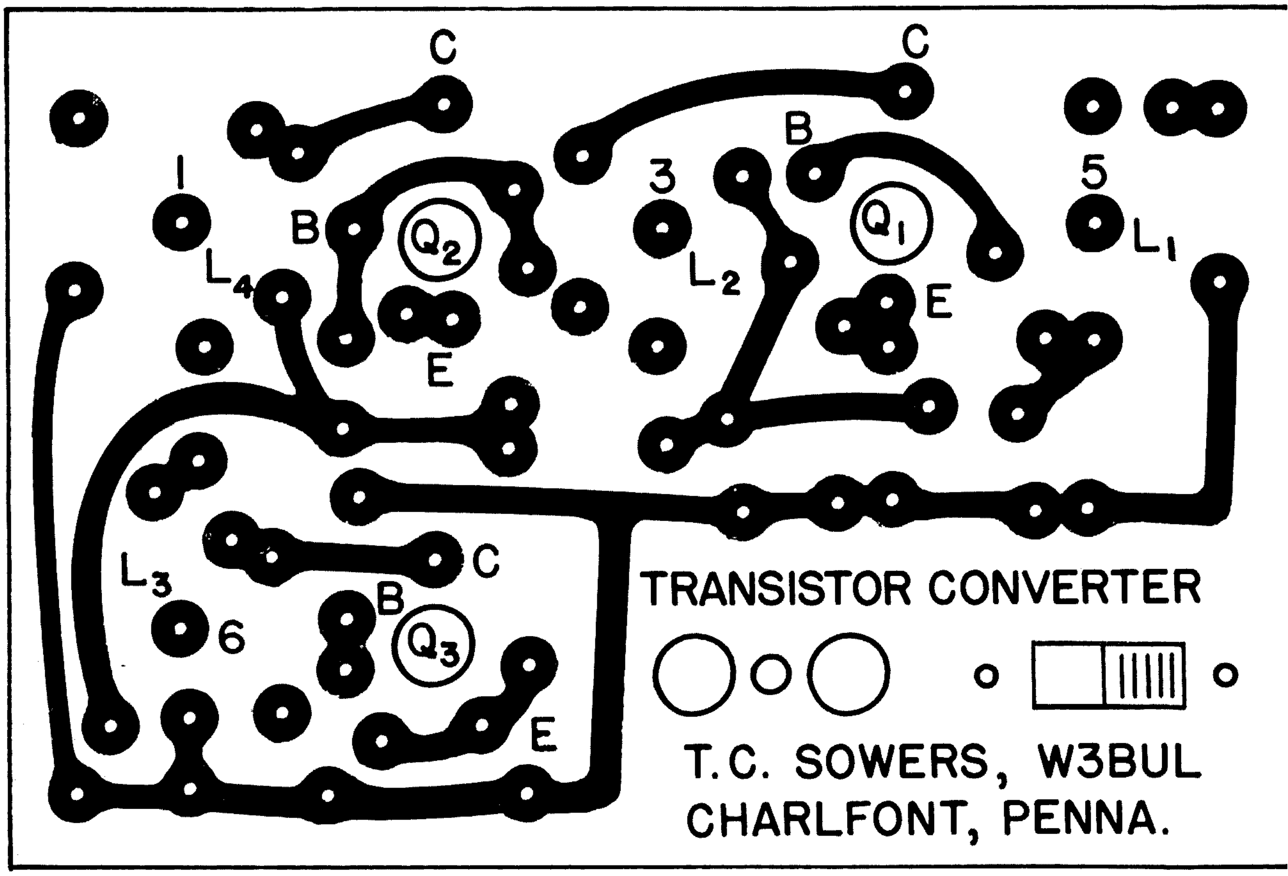


Fig. 2—Bottom View

give much better results and bring in the weak signals.

The early experiments were made using the PHILCO MADT 2N502A and 2N1158A Military type transistor. These transistors will oscillate well over 500 mc but prove to be too expensive for the average amateur and also are much more valuable for frequencies above the ten meter band. The availability of the PHILCO MADT T1832 and the T1833 at $2.93 at the time of this writing makes the x-sistor converter almost as inexpensive to construct as it would to construct a converter using the old fashioned, power consuming tubes which they replace.

The first model using the Military transistor was constructed on a brass chassis and was not crystal controlled. Transistors are sensitive to temperature changes and there was considerable chasing on the auto radio dial in order to keep a signal audible. The final design is a printed circuit board, a crystal controlled oscillator circuit and a self-contained power supply. The completed circuit board is mounted on a 6 x 4 x 2 inch Bud aluminum chassis. The power supply is a Mallory No. TR-146R mercury battery and is mounted under the chassis. The total current drain for the x-sistor converter is 2.5 to 3 ma so the battery should last for 3 or 4 months. The measured overall gain was 28 db at 29 mc with a loss of 2—3 db at 28.5 and 29.5 mc. The gain may be increased at either end of the band by peaking the coils at the desired section.

The writer has been using the x-sistor con verter for several months on ten meter mobil work with excellent results. A test has als been conducted side by side to a crystal co trolled and a well known commercial unit wit comparable results. Several amateur frien have constructed the converter and claim satis factory performance and feel that the con struction was a really worthwhile project.

The Circuit

If we follow the circuit diagram of the x sistor converter in Fig. 1 we see the antenn is capacity coupled to the antenna coil L through C1. The signal is then fed from t tap on L1 to the base of Q1 which is the amplifier. This signal is then capacity couple to the base of transistor Q2 which is used a mixer, and also to the base of transistor Q which is the oscillator. The signal from t collector Q3 appears across the primary L3 and a portion of this is tapped off for fee back through the 28 mc crystal into the emitte The oscillator injection is link coupled to t emitter of the mixer Q2 from the single tur of wire over L3. The collector circuit of t mixer transistor is tuned by L4 to the *if* the auto radio. Stabilization is provided in th emitter circuits with resistors R3, R7, and R1

The circuit board, being the platform construction, must be made first. This is not a difficult as it may at first seem. With a littl

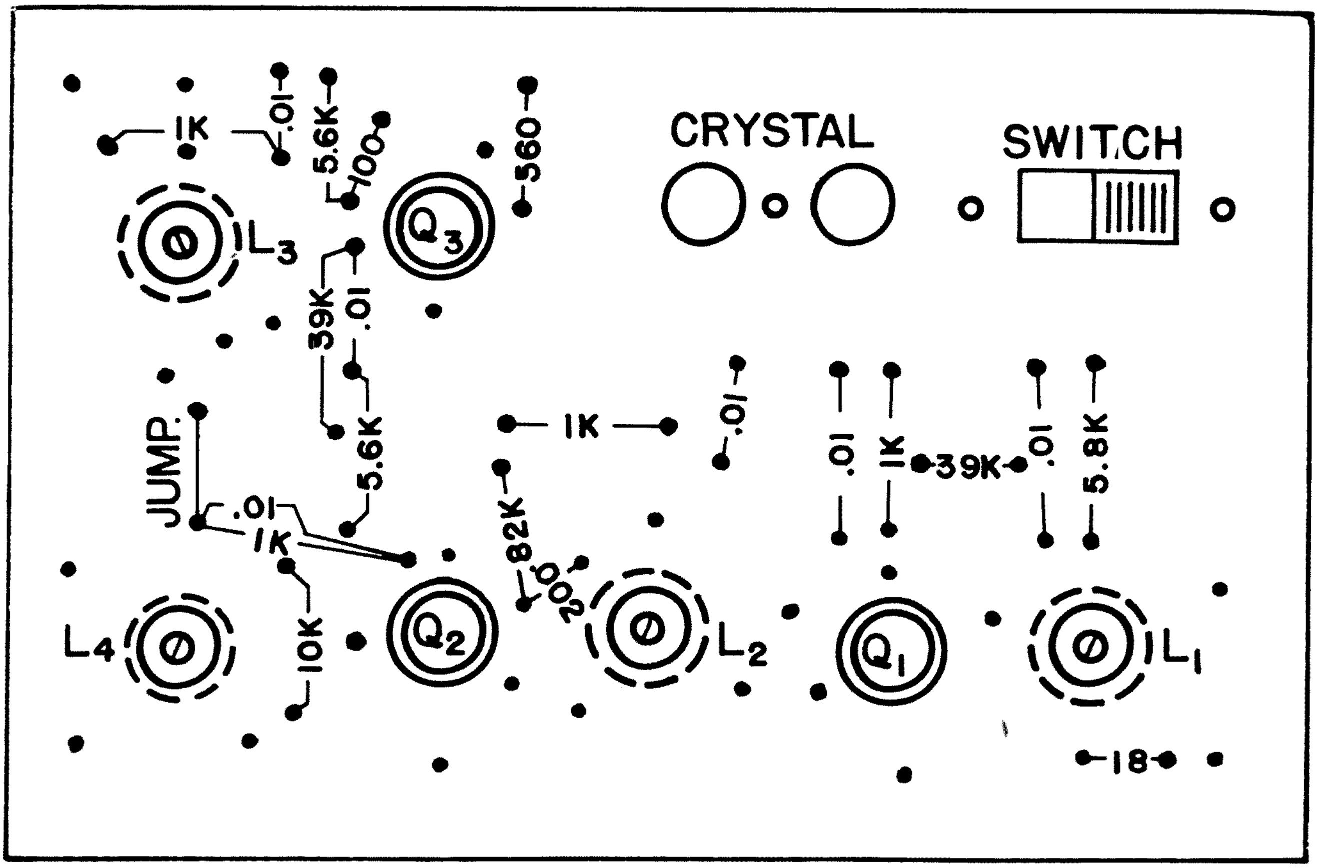


Fig. 3—Top View

patience and a couple of hours of effort a professional looking circuit board will be the reward.

Material List for Circuit Board

1. Copper clad laminate board 3 x 4½" (Lafayette Radio MS-512 or equivalent).
2. Tape resist circles 3/8" diameter (Lafayette Radio MS-737 or equivalent).
3. Tape resist 1/16 x 320" (Lafayette Radio MS-735 or equivalent).
4. Etchant 6 oz. (Lafayette Radio MS-729 or equivalent).

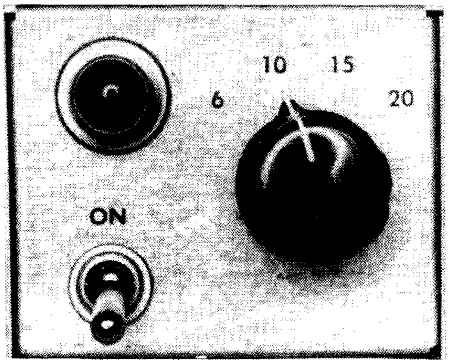
Start with the copper clad laminate circuit board material and layout as per Fig. 2. The simplest method is to take Fig. 2 and place it over the copper side of the board with a piece of carbon tracing paper between. Trace points one through seven for the coil forms and the transistor mounting holes, then continue tracing the circles and connecting bars throughout the entire circuit board. After tracing, it is a simple matter of applying the tape resist circles to the circles you have traced and apply the 1/16" tape resist for the connecting bars. After the resist tape circles are applied remove the small centers which are punched through. By removing these centers, this will after etching, leave small centering points for drill spotting. Apply a tape resist circle to the board for spotting transistor and coilform mounting holes.

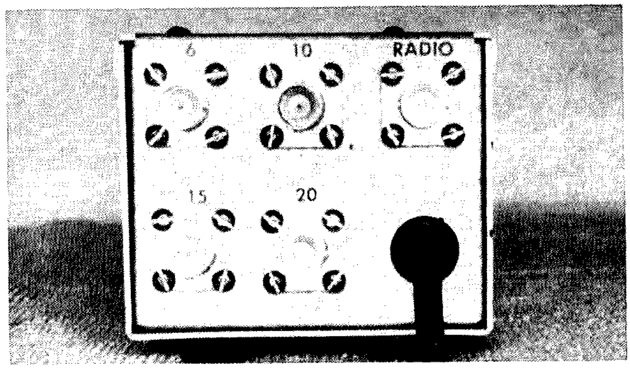
. . .

Another method of constructing the circuit board is to lay out and drill holes for the coils and transistors and temporarily mount these parts. Following Fig. 2, apply tape resist circles and 1/16" resist tape as nearly as possible to the drawing, being certain enough spacing is permitted for mounting resistors and capacitors as shown in Fig. 3.

After the resist tape is completely applied, roll it down tightly with a round bottle or jar and the board is ready for etching. Pour etchant solution into a glass dish or plate. The author used an old soup bowl which had a flat bottom. Immerse the circuit board into the solution with the copper up and agitate slowly. The board may be removed, rinsed in clear water and examined after about 10 minutes of etching. The process may have to be repeated several times, being careful not to over etch as this will tend to undercut the resist tape. The entire etching time should be 20 to 30 minutes in the solution. When all the excess copper has been dissolved rinse the board thoroughly with clear water. To eliminate any possible further chemical action wash the board in a solution of one tablespoonful of baking soda to one pint of water for 30 to 45 seconds. The resist tape may now be removed, and if the above instructions have been followed closely you should have a neat clean looking printed circuit board. The next step is to drill a 1/16" hole through the center of each copper circle for mounting components and drilling holes for the coils and transistors. When drilling holes for

(Continued on page 59)





MANY new hams start off their amateur radio career with either a low cost or out-moded receiver. "You've got to hear 'em to work 'em," to coin a phrase, and these receivers generally sound almost as if they're turned off when you tune above twenty meters.

A Complete Four Band Crystal Converter

Donald A. Smith, W3UZN
Associate Editor.

One of the simplest solutions to this problem, other than shoveling the cabinet of the old receiver full of dollar bills and heading for the nearest dealer for a trade on a new Super Band-Banger DeLuxe, is to put some "hot" converters in front of the old relic and then stand back.

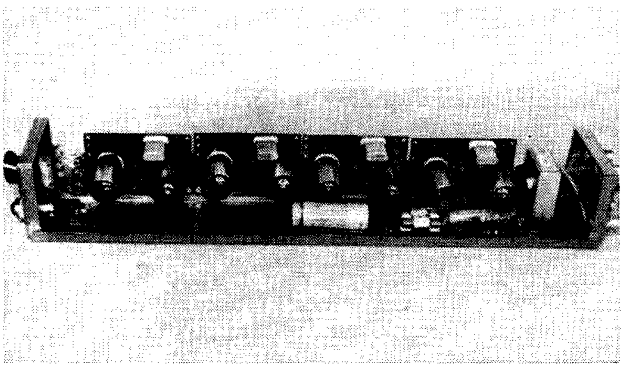
International Crystal Company has a whole series of converters which are so reasonable that it is a shame not to buy a set and build 'em into your station. All I did was put four of them on one chassis, complete with a power supply so it wouldn't be necessary to put any extra drain on the receiver, install an antenna and filament switching arrangement, and I suddenly had the equivalent of a good receiver. Since the output of these converters comes in on the broadcast band you can connect the unit to just about any receiver and get good ham-band reception.

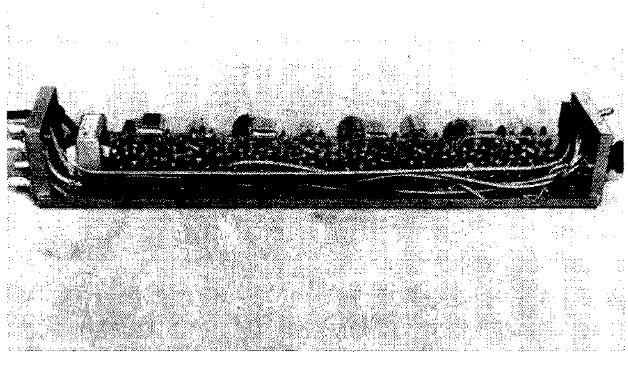
The 20, 15, 10, and 6 meter converters were my choice. You may prefer to add the 11 meter Citizens Band converter and make it five bands. Permission granted. Be sure, when you order your converters, to specify the BC if of 600-1600 kc.

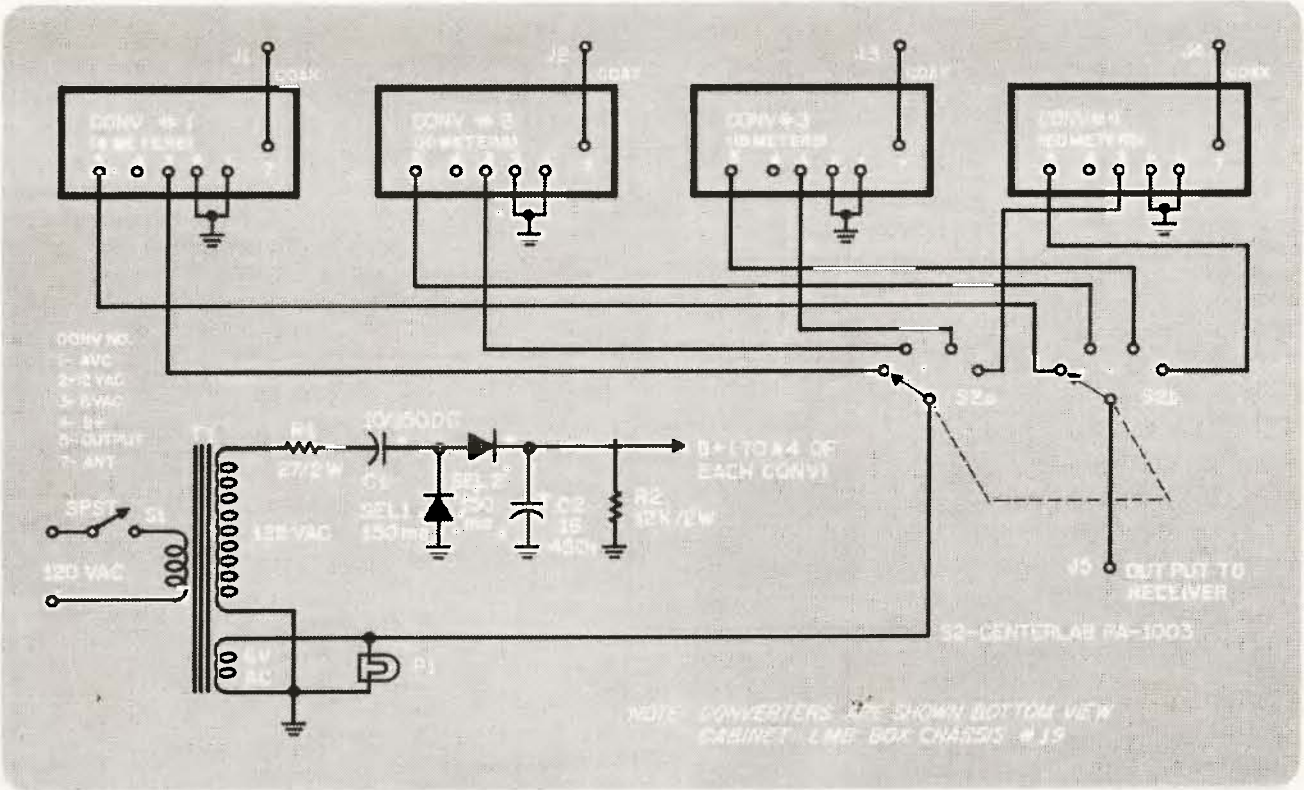
The only connection between this unit and your receiver is the antenna. This means that you can use this with any of the ac/dc receivers such as the National SW-54 and the Hallicrafters S-38. Sensitivity should run better than 1 microvolt, which is darned good.

Construction

A long slender case is used to house the converters and power supply. This may appear unusual, but it is less demanding on desk space. It may be placed next to the receiver, bolted under the desk, or in any other convenient spot. The converters are mounted on their sides by means of small right angle brackets. They come with holes in each corner, so the printed circuit boards do not have to be drilled. The converters are mounted with the crystals up and the terminals down close to the chassis.





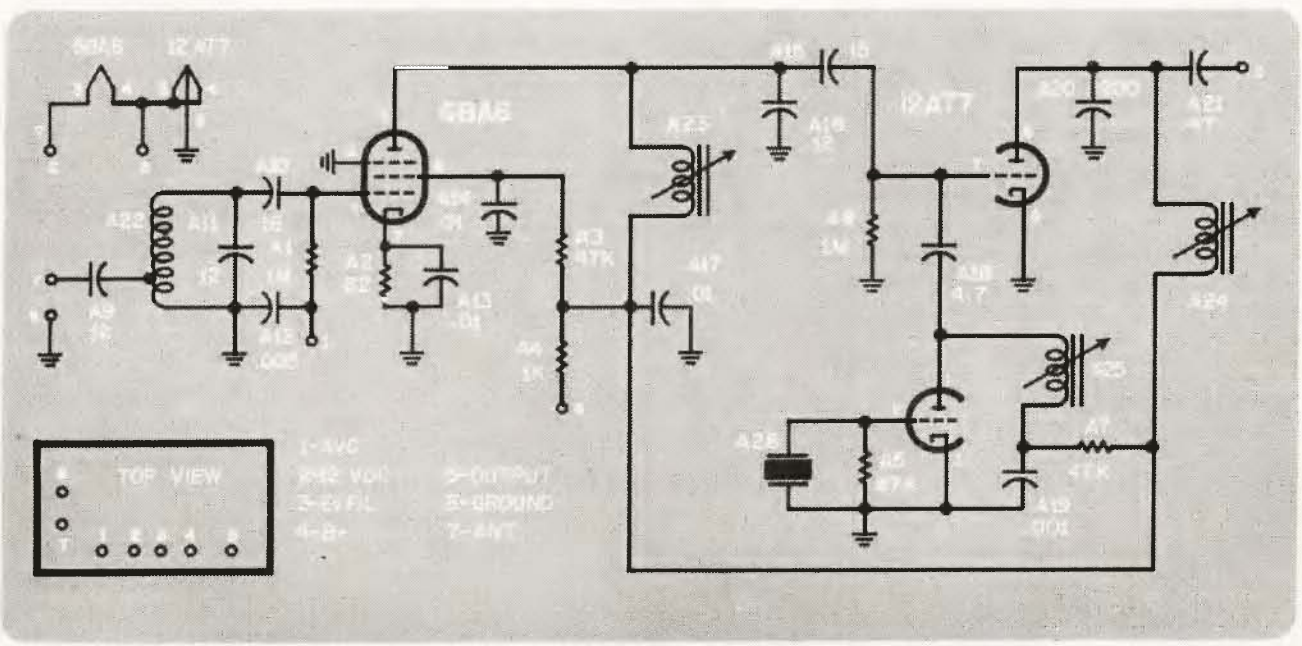


Study the photographs for the layout of the other parts, such as the power transformer, silicon rectifiers, filters, etc. The antenna jacks (BNC connectors), are mounted on the back of the chassis, and the off-on switch, selector, switch and pilot lamp on the front. Note that small coax cable is used to connect each antenna connector to its converter. Regular insulated shielded cable (small) is used to connect the output of each converter to the selector switch as the losses at BC frequencies are not high and the shielded cable works fine. B+ voltage from the supply is connected to the B+ connection of each converter and the filament voltage is switch by the band selector, S2.

Adjustment and Operation

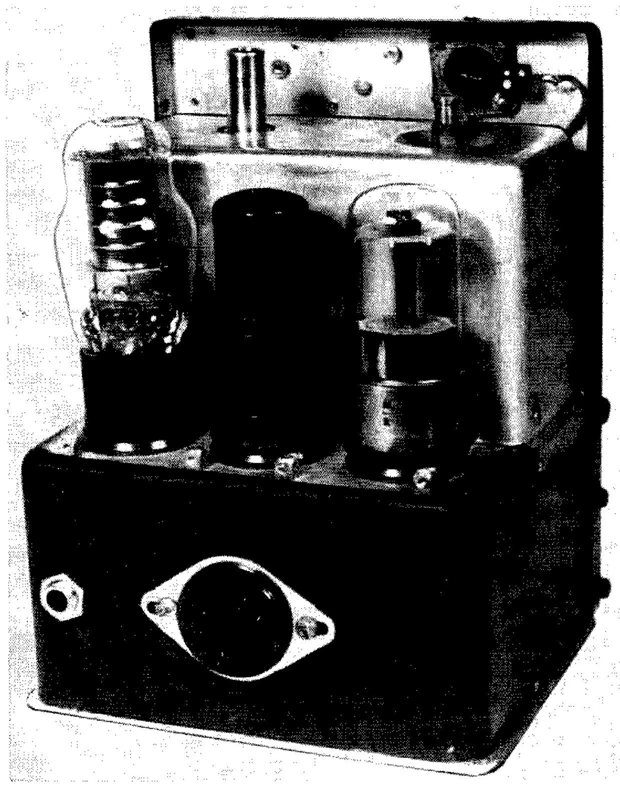
The converters are aligned by the manufacturer, but with 6 meters, where only a portion of the band is generally used, an increase in performance can be had by peaking the three coil slugs in the middle of the band you will be using.

Performance was increased by 12 db on ten meters when the unit was used with an S-40B. Quite a difference! The unit is easy to construct and should give the Novice or Technician no problems. If you want a four band converter you will have to build it, since it can not be purchased. 73



FM VFO Exciter

D. L. Cabaniss, W1TUW
165 Matthews St.
Bristol, Conn.



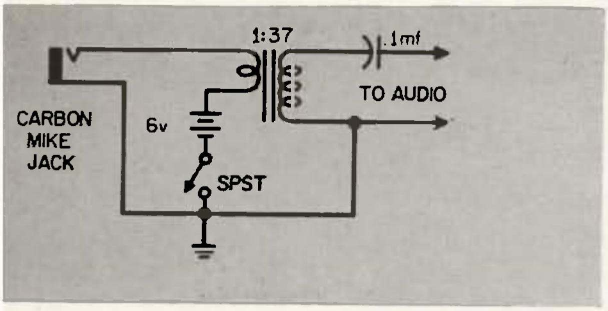
HAVE you been listening on 10, 6, or 2 meters lately? If so, then I'm sure you have heard quite a few amateurs using narrow (and wide) band FM. With the advent of all the surplus commercial FM gear now appearing on the ham market, many amateurs have installed these single and multi-channel units in their automobiles. The advantages of mobile FM cannot be appreciated until you have tried it!

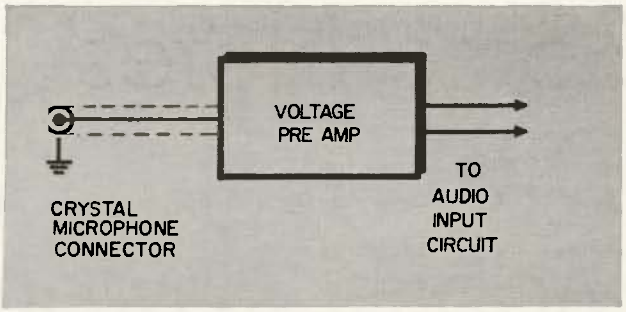
Those familiar with the operation of FM equipment know that a FM signal may be tuned in on a AM receiver by tuning to either side band (slope detection). However, the reverse is not true. An FM receiver will not receive an AM signal. FM receivers are designed to purposely "wash out" any amplitude variations appearing on the received carrier, whether these variations be in the form of noise or AM modulation. IF and limiter stages in FM receivers run at low plate voltages and are designed to saturate above a small signal level.

All this boils down to one fact; you can hear the FM mobile on your home station receiver, but the mobile station will not be able to copy your AM signal on his FM receiver.

The best way to solve this problem (other than purchasing a surplus FM transmitter) is shown in the photograph; a cut-down version of the 40 meter ARC-5 (BC-459) transmitter with a built-in reactance tube modulator. It took the author about three evenings to build it up and it performs like a million bucks.

However, to modulate *this* VFO with a reactance tube proved to be somewhat of a problem. Those familiar with the operation of a reactance tube modulator know that the reactance tube is usually connected to the tuned plate circuit of the oscillator and the plate of the reactance tube is usually at the same rf and dc potential as the plate of the oscillator. When the grid voltage of the reactance tube changes (this change in voltage resulting from speaking into the microphone), the plate current of the reactance tube changes, thus





:anging the current through the tuned plate rcuit of the oscillator and shifting the osllator frequency. However, the oscillator plate cuit of the ARC-5 transmitter is at rf ground ɪtential through a .05 mfd capacitor (refer the circuit diagram). After considerable exrimenting, I wound up with a modified retance tube circuit connected to the oscillator id circuit.

The maximum fundamental frequency shift my particular unit is approximately ± 1 . Feeding this unit into the crystal socket my Apache, and multiplying up to 10 meters es a carrier swing of ± 4 kc (8 kc banddth). Above 29.000 mc, wide band FM is rmitted, so the deviation control may be n full open. However, below 29.000 mc, FM must be used so the deviation control ould be cut back to produce a fundamental cillator swing of .750 kc. This produces a rrier swing of ± 3 kc (6 kc bandwidth) on meters. If the exciter is used in the 8 to mc region for multiplication up to 6 meters, termine the carrier swing by multiplying e oscillator swing X 6. If the unit is used 2 meters, multiply the oscillator swing X (in the 9 mc region) to determine the carer swing at 144 mc. (My particular unit has en used on 10 meters only, but if sufficient ages of multiplication are available, the unit ould perform very well on both 6 and 2 meters). The deviation control therefore has a different setting for each band of operation. The ARRL Handbook contains excellent information pertaining to the calibration of FM exciters. It is suggested that the builder consult the Handbook and determine the oscillator swing before using the unit on the air.

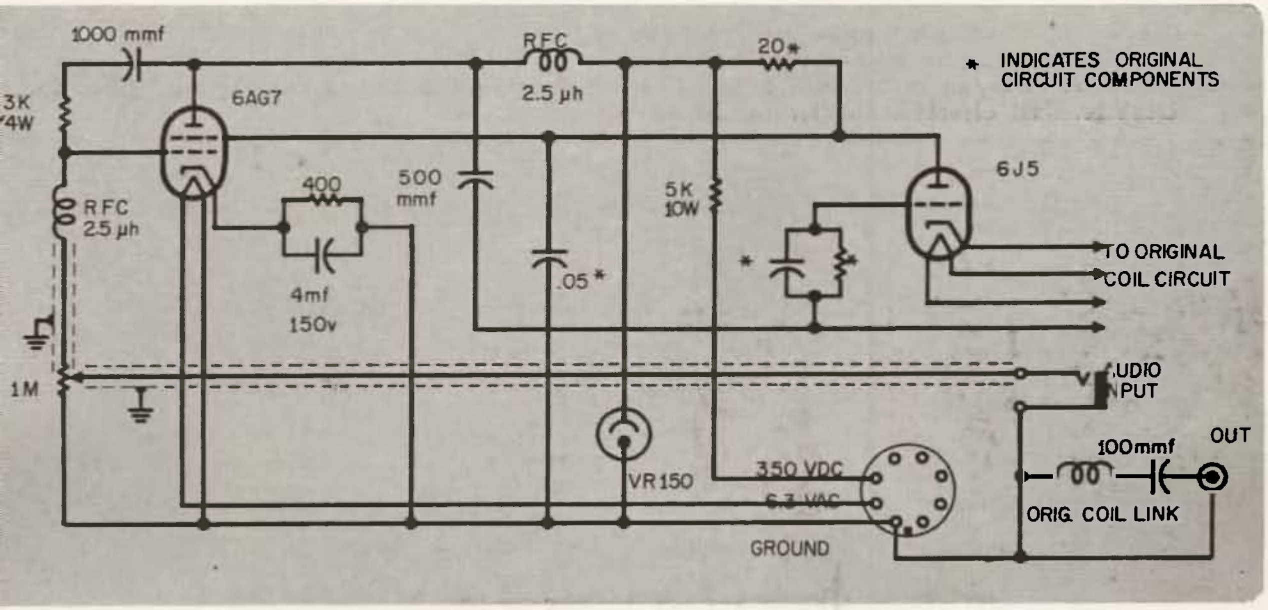
Construction

You can build this FM-VFO without hacking up the BC-459, but it does make a neater unit if you do chop it in half. If you follow my lead you will use the variable condenser which is attached to the front panel to tune the VFO and take out the other one plus the fixed condenser. Remove almost all of the wiring, leaving only those wires coming from the VFO coil unit. It is a good idea to replace the power socket with a regular octal tube socket.

Replace the 12 volt 1626 oscillator with a 6J5. Wire in the 6AG7 reactance tube in the center socket and the VR tube in the remaining socket.

The photos show almost everything else. You can put tape behind unused holes, putty them in with metal putty, sand and paint.

The reports I have received with this exciter driving my Apache have been very good and the FM mobiles have stopped calling QRZ? 73



Some Notes On Mobile Power

Jim Kyle, K5JKX/6
Asssociate Editor 73

For many persons, the problem of power for a mobile rig was solved a couple of years ago with the introduction of the transistorized dc-dc converter and its amazing efficiency.

For others, however, the transistorized power supply didn't prove to be the solution to the problem. This is the story of another high-efficiency answer to the ever-present problem of the mobile ham—power.

Though the transistorized supply is admittedly vastly superior to the older high-voltage sources in both utilization of battery power and in ease of operation, it does not permit an appreciable increase in transmitter power.

Yes, with a good transistorized unit you can run a 100-watt mobile while dynamotors restricted you to 50 watts and vibrapacks were doing well to power a 10-watt peanut whistle. But the difference between 100 watts and 50 watts is only 3 decibels, and that's less than half an S-unit.

Taking into consideration the relatively inefficient antennas usually available for a mobile rig and the poor location conditions usually encountered, it's not hard to see that a mobile unit must have high power to be certain of contacts.

If your only interest is gabbing with the gang on your way to and from work each day, this business of "certain contacts" may not b important to you. However, if you ever plar to use your mobile gear in civil defense o disaster work, the more power the better. An no one likes to be drowned out by a 100-wat home station.

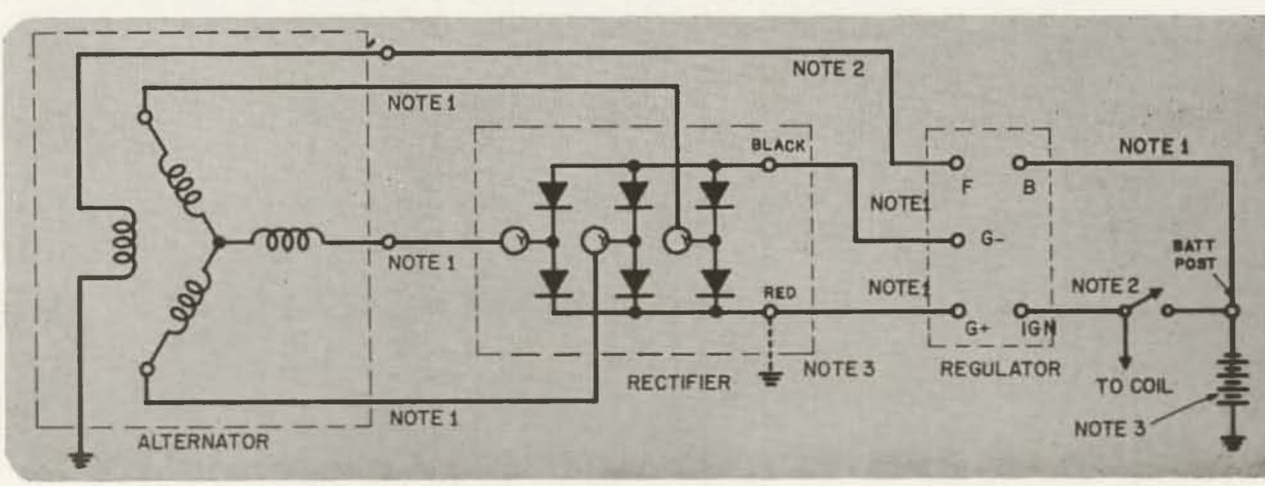
The limiting factor which keeps most mobil installations below the 100-watt power level i the car's own power system. Almost n standard generator will deliver more than 50 watts—and this can only be attained at speed above those considered safe in urban traffic.

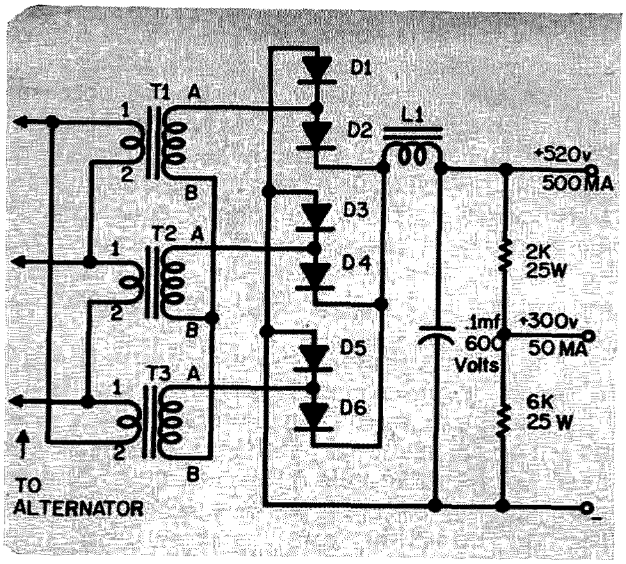
Of this maximum 500-watt capability, mor than 100 watts are normally consumed by th auto ignition and instrument system. Anothe 150 watts or so go into the lights during nigh driving. This leaves only some 250 watts avail able for powering any accessories, keeping th battery charged, and running a ham station— and this is all calculated on the basis of 60 to 70-mph speeds. At 35 mph, there's almos nothing left over.

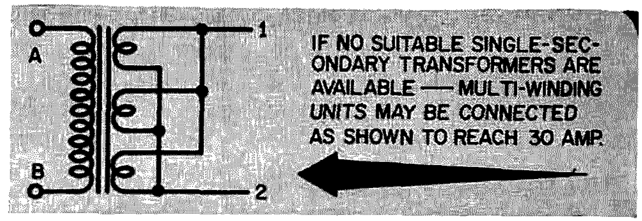
At traffic speeds, you can see, the mobil ham station must draw all its power from th battery. The battery will normally deliver abou 200 watts for one hour before giving up an quitting. Most mobile operators have alread learned this, and carry a pair of heavy jumpe cables with alligator clips to steal power fron

Fig. 1—Schematic Diagram, Alternator Installation

NOTES:
1—Use No. 0 electric-welder cable for these leads.
2—Use No. 14 auto primary wire for these leads.
3—Schematic as drawn is for positive-ground system. For negative ground, move ground point to black terminal of rectifier and reverse field-coil connections.







PARTS IDENTIFICATION:

T1, T2, T3—Surplus 400-cycle fil. XFMR, 120-volt pri., 6.3-volt sec., 30-amp sec. rating. Connect backward.

D1 thru D6—Silicon diodes, 600-volt PIV, 500 ma. Mallory IN 2093 units may be connected in series to reach this rating, as can Audio Devices 30-B5 units.

L1—1 henry choke (Merit C-2996 or equivalent).

Fig. 2—Schematic diagram, 3-phase delta-wye full-wave power supply for use with mobile alternator system.

nother car's battery after an extended session on the air.

These facts may seem to limit all mobile quipment to the low-power classification. Iowever, there's a way around them—and hat's the thing this article is all about.

The power limit imposed by the car's electrical system is traceable directly to the generator. Shunt-wound dc generators are notorious for poor current regulation with varying speed, and any dc generator is limited in urrent capacity by the brushes and comutator.

Neither of these difficulties are present in an c system. For many years, alternating-current ystems for automobiles have been available. Ianufacturers include Delco-Remy Division f General Motors, and the Leece-Neville Co.

Using an alternator in place of the generator, the car's power system has a 300-watt apability with the engine idling, and this gure rises to 700 watts at a speed of 20 mph. t's no wonder that police and emergency ehicles have long used alternators for power.

The main drawback to an alternator system has been the cost. The current price of a eece-Neville 700-watt 12-volt unit, with do-yourself installation, is slightly over $250. he Delco unit is slightly more expensive.

However, these prices are for factory-new quipment. Used alternators can be bought for eanuts—almost.

Least expensive are the 6-volt units, which re being advertised for $40 complete with ectifier and regulator and can occasionally be ound cheaper (at one time the author was ffered three new 6-volt alternators for $5 ach, complete). Used 12-volt systems can be urchased for $85. Best place to check for iese is in the classified ads of Ham Swap. If u find none there, ask your local police-radio epairman.

Installation of an alternator is simple but rty. Remove your old generator and voltage egulator. Get a mounting bracket for your iodel auto from the local Leece-Neville or Delco distributor (average cost, $5). Bolt the alternator in place where the generator came out, and install the regulator in place of the old regulator. The rectifier can be mounted either on the fender or behind the grille, depending on space available in your engine compartment.

If you get a new alternator, it will include a cable kit. A used one may not include the cables. If you have no cables, make them from No. 0 welding cable to the size necessary. Follow the schematic diagram, Fig. 1, for routing of wires and connections.

If your battery has been in service for some time, it will be best to replace it when you install the alternator. Get a good, glass-plate unit, and you'll never have a dead battery again. Batteries which have been allowed to remain partially discharged, as is the usual case with a generator-type system, usually go completely dead as soon as the high output of the alternator hits them.

With an alternator installed, your auto-power problem is solved. But that's just half the story—for ac, even 700 watts of it, won't do much for your signal strength. You're going to have to change it to dc to use it.

Vibrapacks, dynamotors, and transistor power supplies can all be used successfully without worrying about battery drain, but there's a far cheaper way once you have an alternator installed. That's construction of a supply which works direct from the alternator. Efficiency ranges higher than 90 percent with such a supply, and there's no wear and tear on the battery or regulator either.

In a 12-volt system, alternator output will be 14 volts, 3-phase, ac, and the frequency will vary from 80 to 1000 cycles as you speed or slow the engine. Conventional 60-cycle power supplies don't perform well under these conditions.

However, a 3-phase high-frequency supply can be easily built using mostly-surplus parts, and the combination of the alternator system and the 3-phase power supply will cost only

slightly more than would a conventional transistor power supply to be used with conventional auto systems.

A schematic diagram of such a unit, designed for 500 volts output at 500 ma (enough to power a 200-watt final and leave 50 watts to drive the exciter), is shown in Fig. 2.

In building the power supply, surplus 400-cycle transformers which can be obtained for less than 50¢ each can be used for the 3-phase step-up system. Proper phasing is essential for correct operation. It can be assured if identical transformers are used for the three legs. Proceed as follows:

Mark one secondary terminal of each transformer "1" and the other "2", taking care to make sure that the corresponding terminal on each transformer bears the same number (it makes no difference whether the start or finish of the winding is 1). Mark the primary terminals "A" and "B" in the same manner.

Connect the 6.3-volt secondaries all in series, terminal 1 of transformer I to terminal 2 of transformer II, terminal 1 of transformer II to terminal 2 of III, and terminal 1 of III to 2 of I.

Connect all "B" terminals of the 120-volt primaries together. Tape the connection. Take output from the "A" terminals.

The delta-connected secondaries are connected to the three output terminals on the alternator. The primaries go to the 600-vol silicon rectifiers as shown on the schematic.

Note that very little filtering is necessar with this circuit. Input frequency varies fro 80 to 100 cycles, and the delta-wye circuit ha only 4 percent ripple at the rectifier outputs (a a frequency six times the input frequency). Fo many applications, ripple is low enough wit no filtering. The choke and the .1 mfd capacito remove most of the residual 480- to 6000-cycl whistle.

If a lower-voltage supply is desired, use o 12.6-volt transformers in place of the 6.3-vol units will cut output voltage in half withou affecting current capability. Rectifiers the need be only 300-volt PIV rating. A dual-vol tage supply, convenient for operating excite receiver, and final from the same unit, is be achieved by use of a tapped bleeder as show in Figure 2.

This power supply brings an end to fle powered mobile operation by necessity—b it does have one small disadvantage. It's thi The auto motor must be running for operatio In most cases, this is all to the good anyhow A fast idle is all that's needed.

Suggested final tubes for use with this cir cuit include four 6146, 807, or 1625; t 4X150A, or any others capable of taking t high-current relatively low-voltage outpu Happy mobiling!

Cardboard Chassis

Jim Kyle, K5JKX/6

TRANSISTOR circuits, unlike their vacuum-tube counterparts, don't need large metal chassis to support the weight of the components.

This isn't news to anyone who's followed the transistor - construction - project literature. Nearly all construction articles specify punched phenolic cards for the chassis.

However, punched phenolic is available only by mail order in many areas, and in all cases proves a bit expensive for the ham with a limited budget. Here's a twist on the phenolic card chassis which retains all advantages and adds a few of its own. Use drafting board or other heavy cardboard instead!

Like phenolic, paper board is lightweight and is a good insulator at the voltages, currents, and frequencies generally encountered when working with transistors.

Unlike phenolic, paper board is easily worked with scissors and needles. Gone are the tedious hours with finetoothed saw and file.

Drafting board, in the small sizes generally used for transistor chassis, can usually be obtained for free from a friendly draftsma Lacking this opportunity, use photo mounti boards. They're available in 16 by 20 inch si from any photographic supply house cateri to the advanced-amateur trade, for less th 50 cents each. One mount board will furni chassis for dozens of projects.

The only "special" tools needed to prepa a chassis are a pencil, ruler, pair of scissors sharp knife, and dividers or a large sewi needle. The dividers or needle are used punch component-lead holes.

First, cut the card to size. If you're plannin to put the finished unit in a Minibox or simil case, cut the card ¼ inch smaller than t inside measurement of the case. This allo room for mounting brackets.

Next, arrange the components on the card you want them. Try to keep all signal-carryi leads as short as possible.

When the layout satisfies you, mark the po tion of each component and its leads on t card. It's helpful to transfer the schema diagram to the card after the layout is made-

marking all connections and indicating all parts values. If you make the marks lightly, there'll be no danger of shorting out components with the pencil lines.

Now get out the dividers or needle and punch all holes. Transformers can be mounted by using a sharp knife to cut slots for the mounting ears.

With all holes punched, it's time to put the components in place. Thread the leads through the holes, and if necessary bend the lead flat against the backside of the card to hold the part in position.

The final step in this construction method is the soldering of all connections. Be sure to insulate bare conductors with spaghetti tubing to prevent accidental short circuits. When soldering semiconductors, use a pair of longnose pliers between the semiconductor and the solder joint to act as a heat sink and prevent damage to the semiconductor.

That's all there is to it, basically. Here are some hints gathered through experience which speed cardboard-chassis construction:

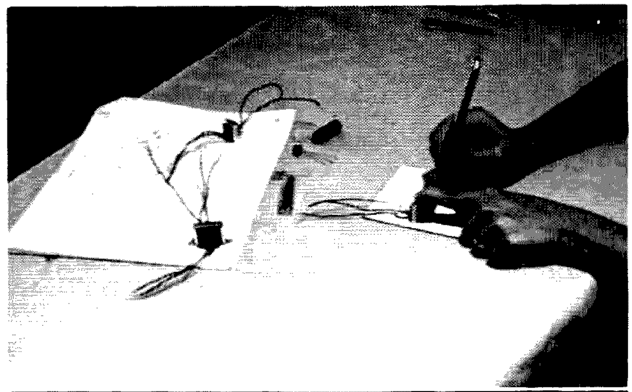
Transistor sockets and cardboard chassis don't go together very well. It's handier to omit the socket and wire the transistor directly into the circuit. Three small holes for the transistor leads hold the component more firmly than would a socket.

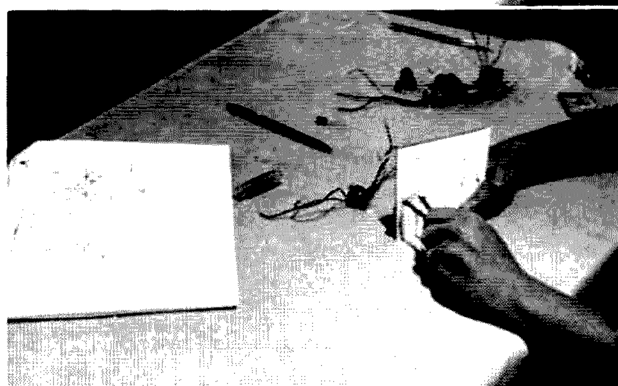
Connections to off-chassis elements should be routed through a binding post. Continual flexing of the lead can cause the wires to break. A 6-32 by ¼ inch machine screw through the cardboard, with its head at the back side of the chassis, works well. Solder a wire into the slot of the screw, using resin-core solder and a very hot iron, to make the connection to the chassis-mounted components.

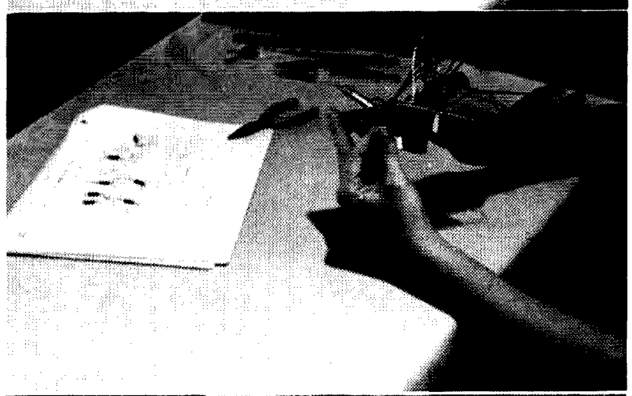
Circuit markings (terminal indications, identification of transistors or other components, etc.) hold up best if marked on the card with India ink rather than pencil.

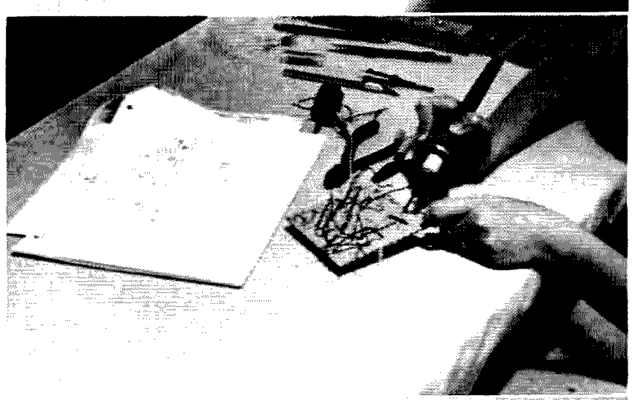
When all wiring is complete and every joint soldered, a coat of clear plastic spray such as Krylon Automotive Grade will protect the finished project. If you need an especially-strong chassis, give the card three or four coats of plastic spray before mounting the components.

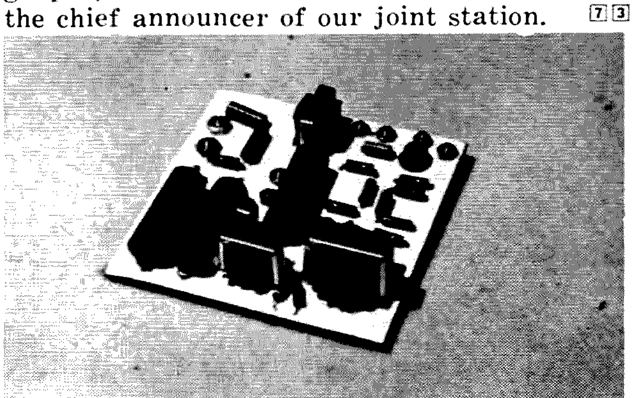
All other details are shown in the photographs, which feature the hands of K5QGO, the chief announcer of our joint station.

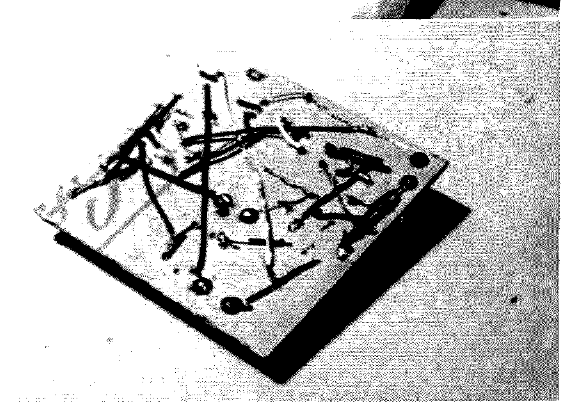












Stop That Noise!

73 Staff

PARTICULARLY when operating mobile, a good noise limiter in your receiver often makes the difference between a contact and a near-miss.

But what is a *good* noise-limiter circuit? This question has faced every ham at one time or another, since nearly every published circuit has at least one major disadvantage or another.

As in many other questions, the only answer to this one is, "It all depends on the situation." The noise limiter which one ham finds perfect may be completely unacceptable to another amateur because of differing requirements.

To help you decide which noise limiter is good for your needs, here's a more-or-less complete listing of the various circuits developed since the days when Signor Marconi tapped out "Sorry, QRN" to his colleagues and sat down to devise a way around static crashes.

Noise limiters can be classified in several manners, as series or shunt, audio or *if*, etc. Here, they're classified as peak limiters and trough limiters, since each of these types serves a separate purpose.

The peak limiter removes spheric crashes, key clicks, and ignition-noise signals from the receiver output, adding to the pleasure of operating. Virtually all limiters included in commercial gear fall into this category.

The trough limiter removes all signals below a certain preset level and allows only signals above that level to pass. It has no effect on ignition or other high-peak noise, but will remove every trace of receiver hiss. When properly adjusted, it will pass more than 90 per cent of an audio signal while erasing all background noise.

Peak limiters fall into two broad categories, series and shunt, according to circuit configuration. Each type has its disadvantages and its advantages.

The series peak limiter generally does a more effective job of removing signals above limiting level than does the shunt type, but it does so at the cost of increased distortion of the limited signal.

The shunt peak limiter is the easiest to add to an existing circuit without changes. Its main disadvantage is a small amount of leakthrough, which shows up as weak noise pulses getting through the limiter.

The series peak limiter consists of a diode, biased for switching action, connected in series with the audio signal path through the receiver. This diode circuit may be either half-wave or full-wave.

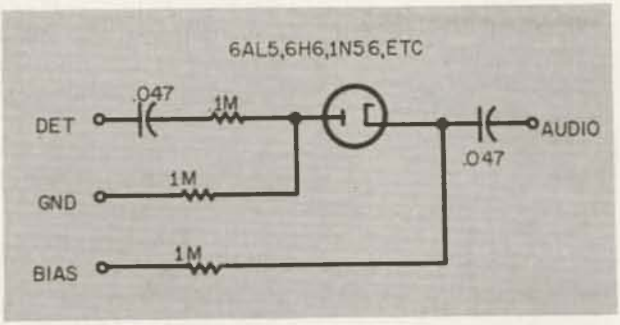


Fig. 1—Half wave series peak limiter.

The half-wave series peak limiter's schematic diagram is shown in Fig. 1. It may be built on a small card chassis and inserted in any receiver as illustrated in Fig. 2. Semiconductor diodes work in this circuit, but be sure to use a unit with high back resistance such as the 1N54. The base-emitter junction of any common transistor (2N107, CK722, etc.) also makes a good diode for this purpose.

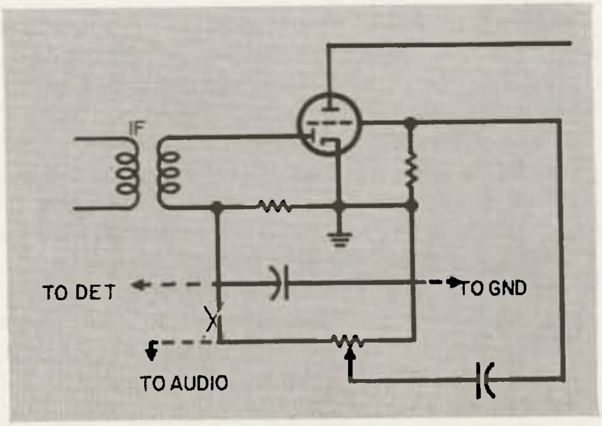


Fig. 2—Connection of series peak limiters.

Here's how it works. The audio signal out of the detector is fed through the input resistor to the diode. When the audio signal is less than the diode bias voltage, the diode is conducting and appears as a short circuit. This lets the audio through to the output side, from whence it proceeds to the rest of the receiver.

A positive peak signal greater than the diode bias voltage drives the diode's cathode positive to its anode, switching it off. There is then no

path for the audio from the detector to the rest of the receiver, and the pulse peak is limited. When the peak passes, the diode recovers and restores the audio path.

A negative peak signal greater than the diode bias voltage will not be affected by the half-wave limiter. However, negative-peak audio (which is positive-peak at the detector input due to phase inversion) is automatically limited at the detector to zero. If the incoming signal is 100 percent modulated, negative peaks will pose no problems.

The full-wave series peak limiter, shown in Fig. 3, was developed to overcome the lack of

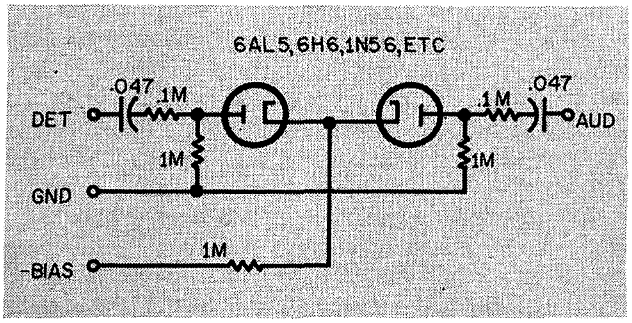


Fig. 3—Full wave series peak limiter.

negative-peak limiting (which proves a handicap if incoming signals are not fully modulated) in the half-wave circuit.

Using nearly twice as many components, this limiter circuit provides positive control of both positive and negative peak levels. It is probably the most effective of all peak-limiter circuits.

Its operation is the same as the half-wave version on positive peaks. Negative peaks above limiting level cut off the other diode in a similar fashion. Limiting level can be varied from less than 10 percent modulation to 100 percent modulation by adjusting diode bias voltage accordingly.

Another version of the series peak limiter, using a triode instead of diodes, has been widely used. It is standard equipment on many of the older Hammarlund sets, notably the early Super-Pro line, the BC- versions of the Pro, and the HQ-129X. The BC-779 version is shown in Fig. 4.

This limiter depends on controlled cathode temperature to achieve its effect, rather than on biased-diode switching. Although it's a bit more complex, it's also more effective than the half-wave diode circuit.

Incoming signals are passed by the triode in cathode-follower fashion so long as they are below limiting level. However, pulse peaks are stopped because the tube runs into saturation-produced by the lower-than-normal filament temperature due to the resistor, and by the low plate voltage. Limiting level is automatic since plate voltage varies with incoming carrier strength.

The filament resistor to produce lower cathode temperature is a good trick to use with any noise limiter, if you use tube-type diodes. It increases reverse resistance and makes the transition from conduction to non-conduction more sharp.

Incidentally, the 'AL5 series of tube-type diodes is generally superior to the 'H6 series in

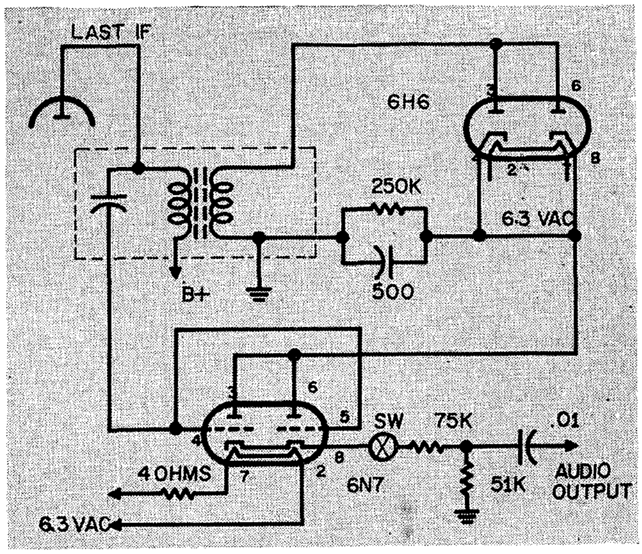


Fig. 4—Hammarlund limiter in BC-779.

noise-limiter service.

The shunt peak limiter is connected in parallel with the audio signal path, rather than in series. Like the series limiters, it may be either a half-wave or a full-wave circuit.

The half-wave shunt peak limiter shown in Fig. 5 is probably the simplest and least expensive noise limiter you can add to any set. With only two components, it adjusts itself automatically to variations in carrier strength. Positive peaks are limited to a value twice that of carrier voltage, while negative peaks are not affected (as explained in the discussion of

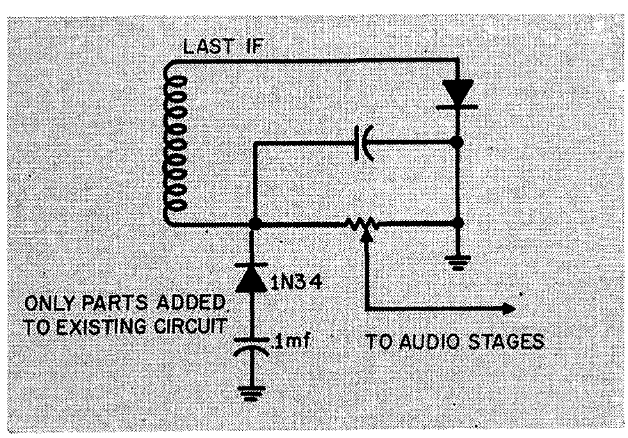


Fig. 5—Simple half wave shunt limiter.

half-wave series limiters).

The shunt peak limiter discussed thus far was, like its series equivalent, confined to audio-peak devices connected to the set at the detector output. This is not the only manner in which the shunt peak limiter can be used.

Shunt audio peak limiters can also be connected at the speaker as shown in Fig. 6. Selenium or silicon rectifiers with at least a

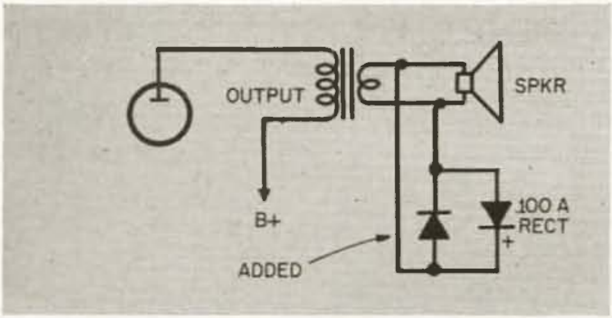


Fig. 6—Speaker shunt limiter.

100 ma rating are recommended for this circuit in preference to tubes or smaller crystal diodes. The full-wave circuit is necessary here.

The speaker-attached limiter has the advantage of simplicity, ease in connection, and adaptability to any receiver without going into the chassis. However, its disadvantages are numerous: It does nothing to the noise peaks before they arrive at the speaker, thus allowing audio stages to overload and to "ring." It has no effect on medium-level noise peaks, thus allowing much ignition noise to get through. Finally, its limiting level is not adjustable, being dependent solely on the characteristics of the particular rectifiers used.

Another point at which the shunt peak limiter can be used is ahead of the detector, in the *if* stages. Many authorities recommend that noise pulses be eliminated as early in the game as possible, thus avoiding overload of *if* as well as audio stages.

The original *if* limiter was devolped more than 25 years ago by Lamb, and is still in use in several receivers—notably, the Pierson and the venerable SX-28 by Hallicrafters.

In this circuit a separate *if* amplifier feeds a noise detector. The output of the noise detector, at a level determined by the limiting-point adjustment, is fed back to the first *if* stage to cut the amplifier off in the presence of a noise pulse.

The original circuit fed the noise detector output to the *if* tube by direct coupling. This allowed a steady but strong carrier a few kilocycles away from the desired signal to cut off the *if* stage even in the absence of noise pulses.

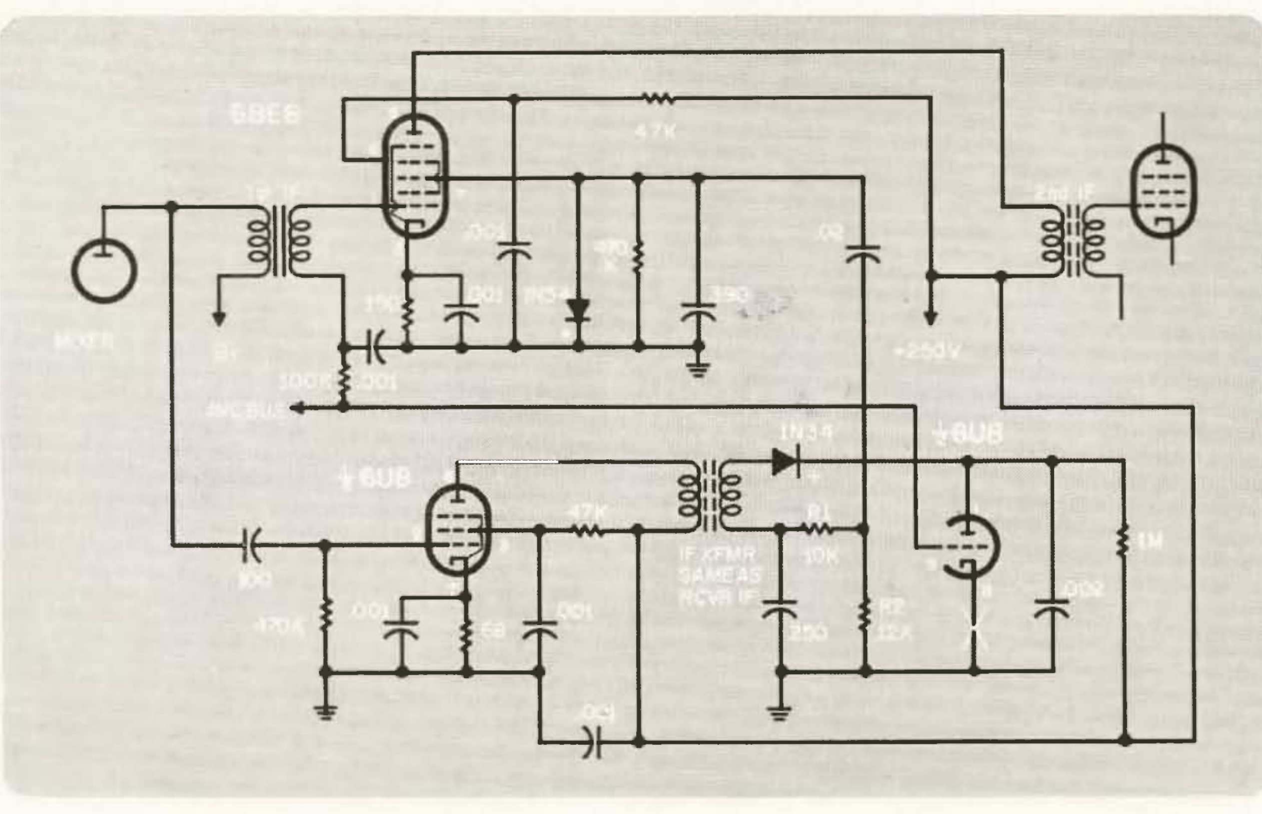
The Pierson version of the Lamb limiter, with ac coupling from noise detector to controlled stage, overcomes this difficulty. An adaptation of the Pierson-Lamb limiter is shown in Fig. 7. It may be built on Vector turret sockets and permanently mounted in almost any receiver.

Advantages peculiar to the Lamb circuit are the suppression of noise pulses *before* they reach the selective *if* circuits and cause ringing; an almost total lack of audio distortion common to most other limiters, and suppression of noise pulses ahead of the AVC line which prevents noise from reducing receiver sensitivity.

The major disadvantage of the Lamb circuit is its complexity. The cost of installing this limiter will run approximately twice that of any other limiter. The extra *if* stage also provides additional sources of trouble as the receiver ages.

Working from the same basic premise stated

Fig. 7—Modified Pierson-Lamb limiter.



y Lamb in 1936—that a noise limiter should e as close to the receiver input as possible—ther designers have developed *if* shunt peak imiter circuits which overcome most of the Lamb limiter's disadvantages. One of these is llustrated in Fig. 8.

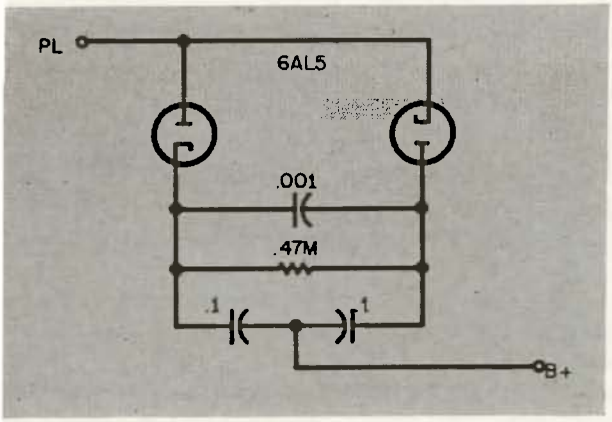


Fig. 8—IF automatic shunt peak limiter.

Operation of this limiter isn't so obvious as ome of the other circuits. With a noise-free nd steady carrier tuned in, there will be a mall voltage drop across the *if* transformer rimary. The two .1 capacitors are charged through the diodes and the resistors) by this oltage.

Each capacitor assumes polarity opposing urrent flow through its associated diode. Un-er these conditions, the diodes are open cir-uits across the *if* transformer primary and he limiter has no effect on the signal.

When a high-amplitude noise pulse comes long, though, the picture changes. The pulse vercomes the bias on one of the diodes (which ne depends on polarity of the pulse) and rives the diode into conduction. In this state, he diode is a virtual short across the *if* trans-ormer and virtually no signal gets through. Vhen the pulse passes, the diode opens up utomatically and the signal proceeds.

Operating as it does from the voltage drop cross the transformer primary, this circuit utomatically adjusts itself to varying signal trength to provide limiting at the 100-percent nodulation point. Connections to any receiver re shown in Fig. 9.

Note that peak limiters in Figs. 1, 3, and 5 re shown with manually-controlled bias oltage.

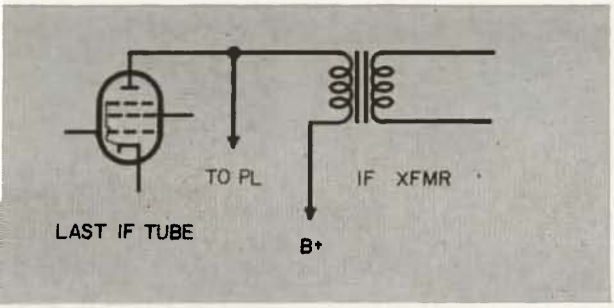


Fig. 9—Connection of IF shunt limiter.

Most operators prefer that their noise limiters be automatic. It's no trouble to make the change in the circuit. Since all circuits shown are arranged for negative bias voltage, the receiver AVC line provides a handy source of bias voltage.

If AVC is applied directly to the bias-voltage input of the limiter, noise peaks will be allowed to rise to twice the peak audio value before being limited. This is because the AVC level represents peak-to-peak value of a 100-percent modulated signal, while the audio peak value is never greater than half this amount and frequently is as low as 25 percent.

The best source of bias voltage for noise-limiters is obtained by removing the AVC detector load resistor from the receiver and replacing it with a potentiometer of the same value. Bring the limiter-bias voltage off the arm of the pot. Adjusting the potentiometer will then give you limiting at any point from 0 volts to twice peak audio level.

For a vernier adjustment, use a potentiometer just half the value of the load resistor and add a fixed resistor in series to restore the original resistance. This gives a range of adjustment from zero to peak audio level.

TNS

Before progressing from peak limiters to trough limiters, a word should be said about the popular TNS developed by W2AEF. Combining noise limiting with squelch action, this may well be the most popular of all limiters for mobile use.

So far as the limiting portion of the TNS is concerned, it's a full-wave series peak limiter. After limiting, the signal is applied to a twin triode which has different time constants in the two plate circuits.

This tube is triggered by the switching action of the limiter diode in such a manner as to prevent any portion of the noise pulse from passing through. (Other limiters hold the pulse to a level consistent with the audio signal, but leave the "stump" of the noise in the signal.)

By adjusting the time constant of one half of the triode, the TNS squelch level may be set at any desired value.

Since it has been adequately described at length in Bill Orr's "Mobile Handbook" the TNS circuit is not shown here.

Advantages of the TNS have already been explained. Here are its disadvantages: Signal input level is critical, in comparison to other limiters. Any signal in excess of 10 volts produces serious distortion. In addition, setting of the squelch control is somewhat of a "hairline" business. Set for too high a level, it prevents weak signals from being heard. Set at the critical point for weak signals, it will be triggered by passing trucks and emit a raucous burst of sound.

These points, however, are minor. The

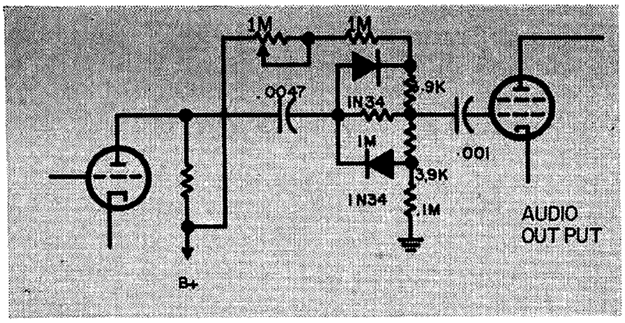


Fig. 10—Trough limiter.

worst disadvantage of the TNS circuit is the one it shares with the Lamb limiter—circuit complexity. With two tubes, a squelch control, and two RC networks, it's virtually impossible to cram into an already-crowded receiver chassis. Most users build it into a Minibox and mount it near the receiver with long leads.

Many noise limiter circuits not shown here have been published. Virtually all, however, are variations on one or more of these basic peak limiter circuits. Now, it's time to look at the other classification—the trough limiter.

Trough Limiter

The trough limiter, an adaptation from computer circuitry, has made only one previous appearance in print to the writer's knowledge. This handy little circuit erases background noise but lets the audio signal through.

This feat is accomplished by limiting, not the peak level, but the trough value of the audio wave. Instantaneous voltages below the limiting level are suppressed, while all above the level go through.

This works with speech because of its syllabic power content — the same reason that SSB amplifiers have a high power rating and that clipping helps increase AM transmitter talk power.

Experiments have shown that more than 10 percent of an audio signal can be removed without losing intelligibility. The trough limiter removes only the low-level portion of the signal—but at the same time eliminates all background hiss.

Although trough limiters can be built in either series or shunt, half-wave or full-wave configuration, only the full-wave series circuit proves practical for communications work (if you like to experiment, any peak limiter using diodes can be converted to a trough limiter by reversing polarity of the bias voltage).

Such a circuit, including its connections to the receiver, is shown in Fig. 10. It may be built on a card or phenolic "chassis" and permanently mounted in the receiver.

In operation, the diodes are biased for non-conduction without signal. Any signal voltage lower in value than the bias level finds an open circuit at the diode and cannot reach the output stage. Bias level is chosen so that random noise is just below the bias-voltage value.

Signal voltage higher than the bias valu forces the diodes into conduction, thus closing the circuit to the output stage and allowing audio through.

That wraps up this discussion of noise-limiter circuits, with advantages and disadvantages listed for every type. With this information, you can now answer for yourself tha question, "What is a good noise limiter?" Simply pick the one whose advantages, for your needs, outweigh its disadvantages, again balanced against your own requirements.

If you want to go deeper into the theory and design of noise limiters, a number of reference works and articles used in the preparation o this article are listed in the bibliography. Happy mobiling! 73

BIBLIOGRAPHY

1. **French, W1JKZ,** The Zero Clipper, *Radi and Television News,* May, 1958, page 40.
2. **Goodman, W1DX,** The Pierson KE-93 Receiver, *QST,* May, 1957, page 43.
3. **Langford-Smith,** *The Radiotron Designer' Handbook*,* pages 694-699 and also pag 1131.
4. **Orr, W6SAI,** *New Mobile Handbook*,* page 81-91.
5. **Orr, W6SAI,** *Radio Handbook*,* 15th Edition, pages 227-231.
6. *Radio Amateur's Handbook,* ARRL.
7. **Stiles, K5ENB,** IF Noise Limiter, *QST,* June, 1960 (see also reference 5, page 229 for this circuit).
8. **Terman,** *Electronic and Radio Engineering*,* 4th Edition, pages 618-621.
9. **Toth,** Noise and Output Limiters, *Electronics,* Nov. 1946, page 114; Dec. 1946, page 120.

**Available from Radio Bookshop.*

New Products

World Globe for Hams

Leave it to Allied Radio to come up with the best world globe deal yet. This is a 12" globe which has all of the country prefixes on it plus an arrangement for you to put on a direction indicator which will give you the direction and distance of any spot from your QTH. The special pivot post allows you to customize the globe for your own location. The globe rotates in either a polar or equitorial plane. Price is only $11.95 from Allied Radio, 100 N. Western Ave., Chicago 80, Illinois.

Measure Your Modulation

Jim Kyle, K5JKX/6
1851 Stanford Ave.
Santa Susana, Calif.

If you're still using AM (as many of us are), you know that you must have adequate modulation level to achieve successful communication.

Many conscientious hams use scopes to monitor their modulation level and guard against overmodulation with its consequent splatter and chances of pink slips. Few, though, have any idea just how great their average modulation level is.

Here's a simple overlay screen for your mod-monitor scope which will tell you your modulation percentage at all times. With this knowledge, you can then do what you like to raise the percentage as close to 100 as you dare.

To use the overlay, have a positive photocopy made at a commercial blueprint supply house, in the right size to fit your scope screen. The exact size you need is determined mainly by your mod-monitor circuit, but the long, vertical side of the trapezoid pattern must touch the two outside lines of the overlay.

The illustration is printed in the proper proportion for many mod-monitors. If the size is right for your monitor, simply trace it from the page onto clear acetate, using India ink and a fine-pointed pen.

Whichever route you take, when you have the finished overlay ready affix it to the face of your scope tube with transparent tape so that the dotted vertical line and the long line marked "100" cross at the center of the tube and the 100 line is parallel to the horizontal deflection of the tube.

Turn on the transmitter and apply a test tone. This may be some 60-cycle ac coupled into the audio from a filament line, or the output of a test oscillator. Whistling into the mike won't produce a steady enough output to adjust the monitor.

Adjust the coupling between the monitor rf input and the final until the vertical peaks of the trapezoid pattern barely touch the "0" lines of the overlay. The overlay may require adjustment up or down to make both lines touch the pattern at the same time.

If necessary, adjust the monitor's horizontal gain control so that the point of the trapezoid (or the short edge, if your pattern doesn't come out to a point) falls in the area covered by the short lines of the overlay.

Now all you have to do is note which overlay line the short edge of the trapezoid rises to, and read off modulation percentage directly. Note that levels higher than 90 percent are almost unreadable—if you reach this level, you'll get out. Broadcast stations are only required to maintain a level of 85 percent.

Here's how the measuring gadget works:

By definition, the modulation percentage of an AM signal is expressed by the formula

$$\frac{E_{crest} - E_{trough}}{E_{crest} + E_{trough}} \times 100.$$

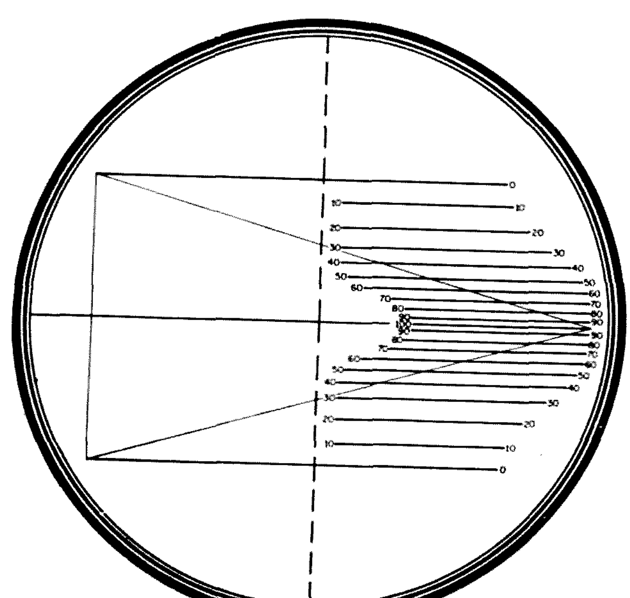
E_{crest} is the peak voltage, and E_{trough} is the minimum voltage, during a modulation cycle.

The conventional trapezoid pattern of a mod-monitor portrays this relationship graphically. The high end of the trapezoid is a measurement of peak voltage, and the low side measures minimum voltage. Audio voltage fed to the horizontal plates simply provides a sweep directly proportional to the modulation cycle.

The overlay pattern is a calculation of the values of minimum voltage for arbitrary modulation levels, in terms of the peak voltage.

Therefore, when peak voltage is adjusted—

(Continued on page 56)



Some Hard Facts About Echo

Don Goshay W6MMU
8352 Westlawn Avenue
Los Angeles 45, California

WELL, the long-awaited balloon is now in orbit, and a spectacular thing it is. Before I read the newspaper, I was aware something big was up (no pun intended) by the space talk across the 144 and 220 mc bands. Soon I came across W6BUT and W6DQJ on two meters making ready to try some balloon bounce on 1296 mc. Fine idea, I thought, and rushed about setting up the 4 foot dish and the crystal controlled rig on 1296 mc.

After the balloon had crossed the sky and no signals were heard, calm again prevailed. I began to wonder just how loud these signals from 1000 miles out in space should actually be. I recalled doing some moonbounce computations a few years ago and dug them out. The moon return signals were weak (on paper), so weak in fact, that only with high power output, large antennas, and extremely sensitive receivers with narrow bandwidth, could the job be done. The W4AO, W3GKP, W6QKI, and W2NLY experiments a few years ago had verified this. In fact, these brave fellows were successful in getting moon returns only a fraction of the times attempted.[1]

So, a similar computation was made for the case of the satellite. First, the satellite was assumed to be a perfect spherical reflector with a scattering cross-section equal to a flat disc of the same diameter.[2] This is actually an accurate approach for a sphere of any wavelengths in diameter. Next, I was interested in determining the strength of my own return signal, and not that reflected to some distant station. This does not involve too much error, but what error there is, is in the direction of a stronger return signal. That is to say, the signal reflected back into one's own antenna will be somewhat stronger than that which might find its way into an antenna at a distant point.

The simplest way to begin this sort of thing is to resort to the standard "Radar Range Equation":[3]

Path loss, including antenna gain

$$= \frac{(4\pi)^3 R^4}{\sigma \lambda^2 G_T G_R} \quad (1)$$

where

R = the distance to the satellite

σ = the scattering cross section of the satellite

λ = the wavelength

G_T = transmitting antenna gain

G_R = receiving antenna gain

If the antenna used to receive the return signal is the same as that which transmitted it, or if separate but similar antennas are used, Gt will equal Gr and then the expression GtGr can be called simply G^2. For a parabola:

$$(2) \quad G = (.5)\frac{4\pi A}{\lambda^2} = \frac{2\pi A}{\lambda^2} \text{ OR:}$$

$$G^2 = \frac{4\pi^2 A^2}{\lambda^4} \quad (3)$$

where A is the physical area of the parabola. Also, for a parabola:

$$(4) \quad A = \frac{\pi d^2}{4} \text{ AND } A^2 = \frac{\pi^2 d^4}{16}$$

where d is the diameter of the parabola. If (5) is substituted for A^2 in (3):

$$(6) \quad G^2 = \frac{4\pi^2}{\lambda^4}\,\frac{\pi^2 d^4}{16} = \frac{\pi^4 d^4}{4\lambda^4}$$

From the assumptions made regarding the scattering property of the satellite:

$$\sigma = \frac{\pi D^2}{4}$$

where D is the diameter of the satellite.

If equations (6) and (7) are substituted for GtGr and in equation (1), the following is the result and defines the total path loss:

$$\frac{Pt}{Pr} = \text{PATH LOSS} =$$

$$\frac{(4\pi)^3 R^4}{\frac{\pi D^2}{4}\lambda^2\frac{\pi^4 d^4}{4\lambda^4}} = \frac{1024\,\lambda^2 R^4}{\pi^2 D^2 d^4} \quad (8)$$

The ratio of the signal received to the signal transmitted is the reciprocal of this:

$$\frac{Pr}{Pt} = \frac{\pi^2 D^2 d^4}{1024\,\lambda^2 R^4} \quad (9)$$

Equation (9) shows that the magnitude of the signal received for a given amount of transmitter power will be directly proportional to:

1) The *square* of the satellite diameter.
2) The *fourth power* of the parabola diameter.

The received signal will be inversely proportional to:

1) The *square* of the wavelength.
2) The *fourth power* of the distance between the antenna and the satellite.

If equation (8) is worked out for the case of ECHO I for 1296 mc and 4 foot dishes, the result indicates a path loss of at least 223 db.

Now if some lucky ham has a 500 watt output (not input) klystron on 1296 mc, his retur signal will never exceed —166 dbm when using

a 4 foot parabolic antenna. If this same fellow has a 1296 mc receiver with a 2 db noise figure (assuming his parametric amplifier is working well), and his *if* strip has a bandwidth of 5 kc, he will just be able to hear a signal of —146 dbm. This means the signal he is looking for will never be any better than 20 db (100 times) below the receiver noise level. This is provided, of course, that his antenna is tracking the satellite perfectly.

The situation could be improved, on paper, by using a larger antenna. But this would narrow the antenna beamwidth and complicate the tracking problem sufficiently to make it impossible, except for the most sophisticated tracking systems.

The next question that might be asked is "how does this performance compare with that when using the moon as the passive reflector?" While the moon is much larger than the 100 foot satellite, is is 239 times as far away. The return signal depends on the *square* of the reflector diameter, but gets weaker by the *fourth power* of the distance.

Path loss $\alpha \frac{R^4}{D^2}$

$$\frac{\text{moon path loss}}{\text{balloon path loss}} = \frac{\frac{R^4\text{MOON}}{D^2\text{MOON}}}{\frac{R^4\text{balloon}}{D^2\text{balloon}}} = \frac{\left(\frac{R\text{MOON}}{R\text{baloon}}\right)^4}{\left(\frac{D\text{MOON}}{D\text{balloon}}\right)^2}$$

$$= \frac{(239)^4}{\left(\frac{2150 \times 5280}{100}\right)^2} = \frac{32.8 \times 10^8}{139 \times 10^8} = .236 = -6.3\text{db}$$

This means that the moon path loss will be about 6 db less than the satellite path loss, or, in other words, the received signal would be 6 db stronger from the moon. This is provided that the moon had as good a reflection efficiency as the balloon. In reality, it does not. A rough guess would indicate the received signal would be about the same in either case.

So if you have been unable to communicate via the moon, the foregoing analysis indicates you will be unable to do so via the ECHO I satellite with the same equipment. The problem is compounded by the satellite's obviously greater angular velocity across the sky over that of the moon.

If you would like to estimate what it would take to communicate via the satellite, the charts given below will enable you to do so without becoming entangled in the astronomical numbers that crop up when using the Radar Range Equation directly. In the example given above for 1296 mc, the signal deficiency was shown to be 20 db. For different equipments and conditions, add or subtract the corrections shown on the chart to the 20 db deficiency. 73

1: **QST**, March, 1953.
2: **"Microwave Antenna Theory and Design"** by S. Silver, Radiation Lab. Series, McGraw Hill. Page 5.
3: **"Reference Data for Radio Engineers"** Fourth Edition, International Telephone and Telegraph Corp. Page 804.

Policies

Here are the basic policies which will guide 73.

Policy #1: We are not mad at anybody.

Policy #2: Amateur Radio, in its dual role as a means of arousing the interest of youngsters and providing the basic training for entry into the field of electronics, one of the largest and most promising fields we can see ahead, and as one of the most important means of communications between the peoples of the world on a people-to-people basis instead of through the press or government channels, is probably the most important hobby in the world today. We can keep it important by being aware of what is going on in our hobby and by being technically up to date. 73 Magazine is dedicated to bringing into focus the frontiers of amateur radio. It will strive to broaden the technical interest of the amateurs and to encourage them to higher technical attainments and abilities by means of technical and construction articles written by the best talent available.

Policy #3: Few talented writers have continued to buck the present system whereby they either receive nothing for their efforts or else have to wait from one to three years for minimal pay. 73 has established the policy of paying for all accepted articles with immediate cash. This seems to be bringing new life to the field for we are receiving top notch articles by some of the best authors in the hobby.

Policy #4: It is our intention, the SEC permitting, to open the ownership of Amateur Radio Publishing, Inc., to interested amateurs so that the ownership of the magazine can be widespread and the magazine will be truly owned and run entirely by licensed hams. 73 is being run under a very tight economy until the break-even point of 15,000 circulation is reached.

Policy #5: We intend to encourage and promote the publication of bulletins to bring specialized operating news of the many facets of amateur radio: VHF, RTTY, DX, Traffic Handling, TV, etc. The Club Bulletin of Marvin Lipton VE3DQX will be one of the first under this program. This publication, which is sent to the editors of all known ham club bulletins to provide them with a means of exchanging ideas, should be back in business this fall.

Improving the Signal to Noise Ratio of the Gonset Communicator

. . . a simple modification for a remarkable improvement

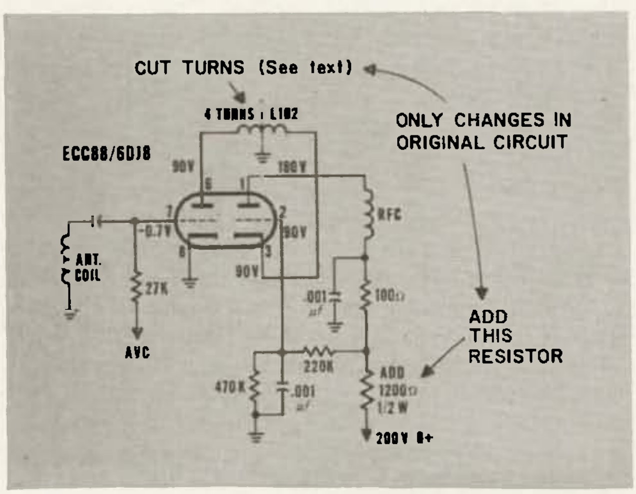
Bill Hamlin W1MCA
17 Post Gate Road
Hamilton, Massachusetts

THE Gonset Communicator is certainly one of the most versatile pieces of ham equipment ever mass produced. I've used mine just about everywhere and really enjoyed it. But, as probably happens to most engineers, the day comes when a professional look comes into the eye and some serious thought is given to hot-rodding it. This may be a natural phenomenon, or it may be a delayed result of reading about 417A converters and parametric amplifiers.

My Two Meter Communicator III was placed upon the operating table, disemboweled, and an autopsy performed on the front end. It became obvious that the designers knew what they were doing and that a major revision was not practical. There wasn't room inside for a parametric and it would be awkward to mount it outside, so I looked further. An easy way out came to mind: a better tube for the receiver's front end. The resulting improvement was beyond all expectations so I'm passing this along for the rest of you to try.

Since World War II, there has been an ever increasing pressure on tube designers for improvements because of the great and growing complexity of electronic equipment of all sorts and the competition of transistors. Tube designers have met this challenge and, even though there has been no real break-through in electron tube theory, there has been many startling new developments in design technology.

Fig. 1



RF Tubes

Better performance of rf amplifiers was brought about in recent years by miniaturization and improved electrode design by modification of prototype structures. The cascode circuit, such as in the Communicator III front end, employing two stages of triode amplification with a specially designed double triode tube seemed to be the culmination of engineering effort for garden variety equipment.

A good rf tube should have a high-gain bandwidth product and low noise which is a result of high transconductance, low interelectrode capacitances and low noise resistance. In tube design this means closer spacing of the grid to the cathode for higher transconductance and finer grid wires to hold capacitances and noise to low values. A practical limit is reached where the grid wires become so fine that they can no longer adequately support themselves

and the spacing is too close for reliable service without shorts.

One approach to the grid problem is to support the grid wires on a rigid frame, thus, the grid wires themselves do not have to support the structure. This is called a frame-grid tube (See Fig. 2). With this type of construction it is possible to cut the diameter of the grid wires to one half that of the conventional tube and also the grid may be moved closer to the cathode.

A New Tube for the Communicator

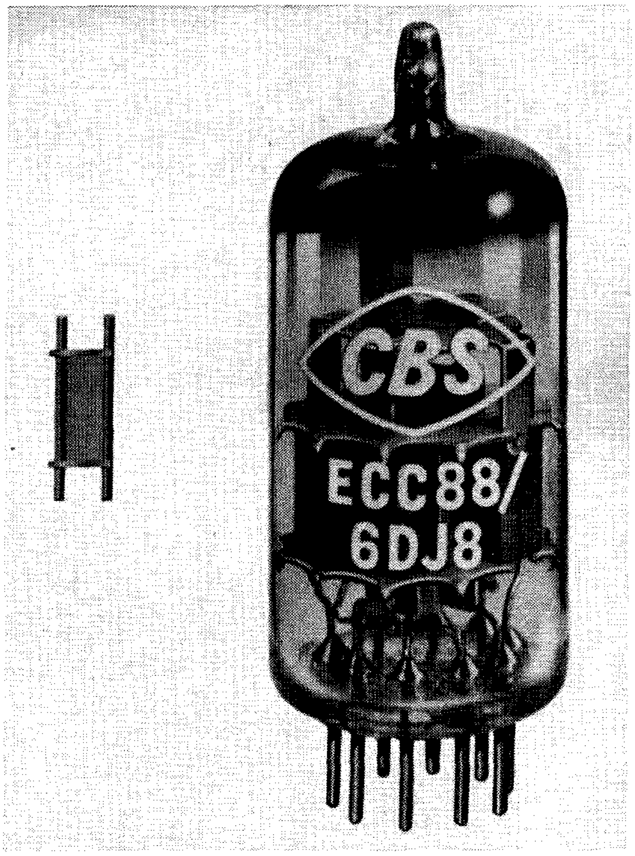
One of the frame-grid tubes that is now readily available is the CBS ECC88/6DJ8. It is a double triode designed for cascode amplifier service. It will replace many conventional American tubes in this class of operation and provide superior performance.

The ESS88/6DJ8 is tailor made to improve performance of the Communicator III front end. It has a transconductance of 12,500 μmhos in typical operation with 90 volts applied, while the 6BZ8 originally used in the Communicator III has a transconductance of only 8,000 μmhos with a plate voltage of 125 volts. The lower plate voltage of the ECC88 indicates lower noise output. In comparison, if the voltage of the 6BZ8 were lowered to 90 volts to reduce noise its transconductance would drop down to about 6500 μmhos. In addition, the ECC88's frame-grid structure with its finer grid wires reduces electron shot noise caused by the random impact of electrons against the grid wires.

To see what adjustments were necessary for substitution, when the characteristics of the ECC88/6DJ8 were compared to those of the 6BZ8 it showed that only the plate voltage had to be adjusted to obtain proper operating conditions. In other words, shifting the plate to a lower voltage brought all other parameters in line so that the grid biases were properly Class A without further adjustment. (Type 6BZ8 operates at Class A with 125v plate, —1.0 volts grid, and 10 ma plate current. Type ECC88 operates with 90 volts plate, —1.3 volts grid, and 15 ma plate current.)

Reducing the voltage of each section of the tube was simply accomplished by inserting one series resistor of 1200 ohms into the B plus power lead. This takes care of both sections of the tube as they are in series in the cascode circuit (See Fig. 1).

One unexpected difficulty arose in that instability and oscillations occurred in several places of the band. This was due to the slightly higher capacity of the ECC88/6DJ8. The resonant frequency of the plate to cathode connected neutralizing coil (L102) with the internal tube capacitances must be lower than the receiver frequency. The instable condition was easily rectified by reducing the size of



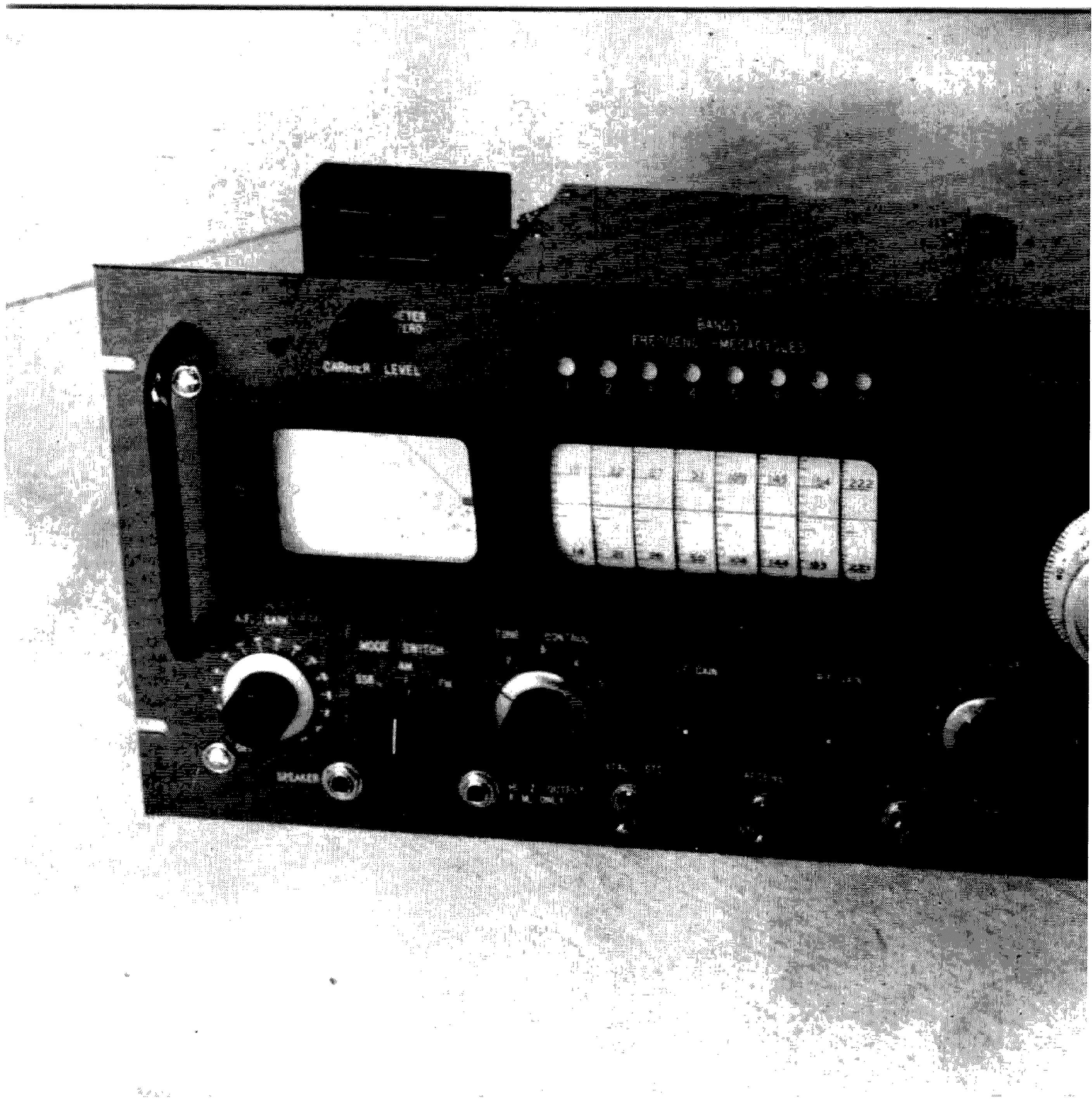
The ECC88/6DJ8 high-gain twin triode with true frame-grid construction is now available from CBS Electronics, manufacturing division of Columbia Broadcasting System, Inc. The grid itself is shown to the left of the tube.

coil L102 to about one half of its original size. L102 can be located going through the shield between tube socket pins 3 and 6. Either wind a new coil of 4-turns and ¼ inch diameter or cut the original L102. Further adjustment may be necessary by stretching the shape of the coil until no spurious oscillations are detected when tuning over the entire 2-meter band.

After these changes are made and the Communicator reassembled, the interstage rf transformer should be peaked with the rf trimmers accessible through the two front holes in the bottom of the case.

The noise level with the new tube is so much lower than originally that it may be a little difficult to tune to maximum on the noise level. If a noise generator is not available, then an incoming signal may be used, preferable a steady low level signal. It should be unnecessary to touch the input stage as it is an untuned-broadband circuit that is effected very little by slight differences in input capacity between the original tube and the new tube.

The completed conversion is so good from the noise stand point that most of the remaining noise is generated in the converter stage. It would now be appropriate to work out a reduction of noise in this area. 73



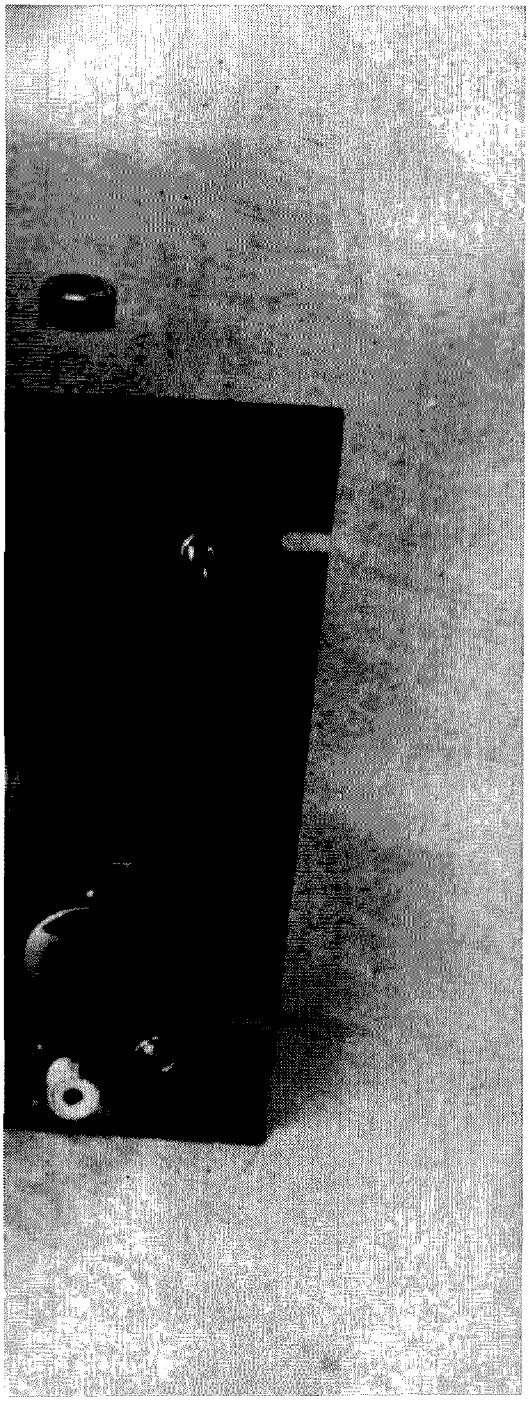
Pictures processed by Joe Kwetnewski W9UTD.

ONE phase of our stimulating hobby that new amateurs and a good majority of old timers shy away from, is the building of receivers. They see them as an octopus or as something more frightening and shield themselves behind the old phrase, "It's cheaper to buy, so why rack your brain?"

This statement only holds water in cases where each and every item of the planned project necessitates fabrication by other craftsmen besides yourself, so even if you get a bargain on construction, costs will mount up to a prohibitive figure. But if man or boy leans toward such past-time, bird watching would be more advantageous than the choice of radio as a hobby.

It's surprising to learn that a receiver is no more difficult to design and construct than is a transmitter or any other electronic device if it's broken down into sections. It does look complicated if you take a peak at the underside of it and see the wiring and the many associated components; but so does a transmitter if you just glimpse at the bottom of it. However, if you separate each tube and their components into stages and just examine each stage in succession, all the mystery vanishes rapidly.

The receiver herewith described required a lot of planning, numerous changes and some borrowed tools before the completed unit was buttoned up as a finished project, but believe



Tri—Mode VHF Monitor

John Wonsowicz W9DUT
4227 N. Oriole Avenue
Norridge 34, Illinois

me, it was a challenge and fun immensly enjoyed, for there is nothing that will give you more self satisfaction than self expression in your chosen art.

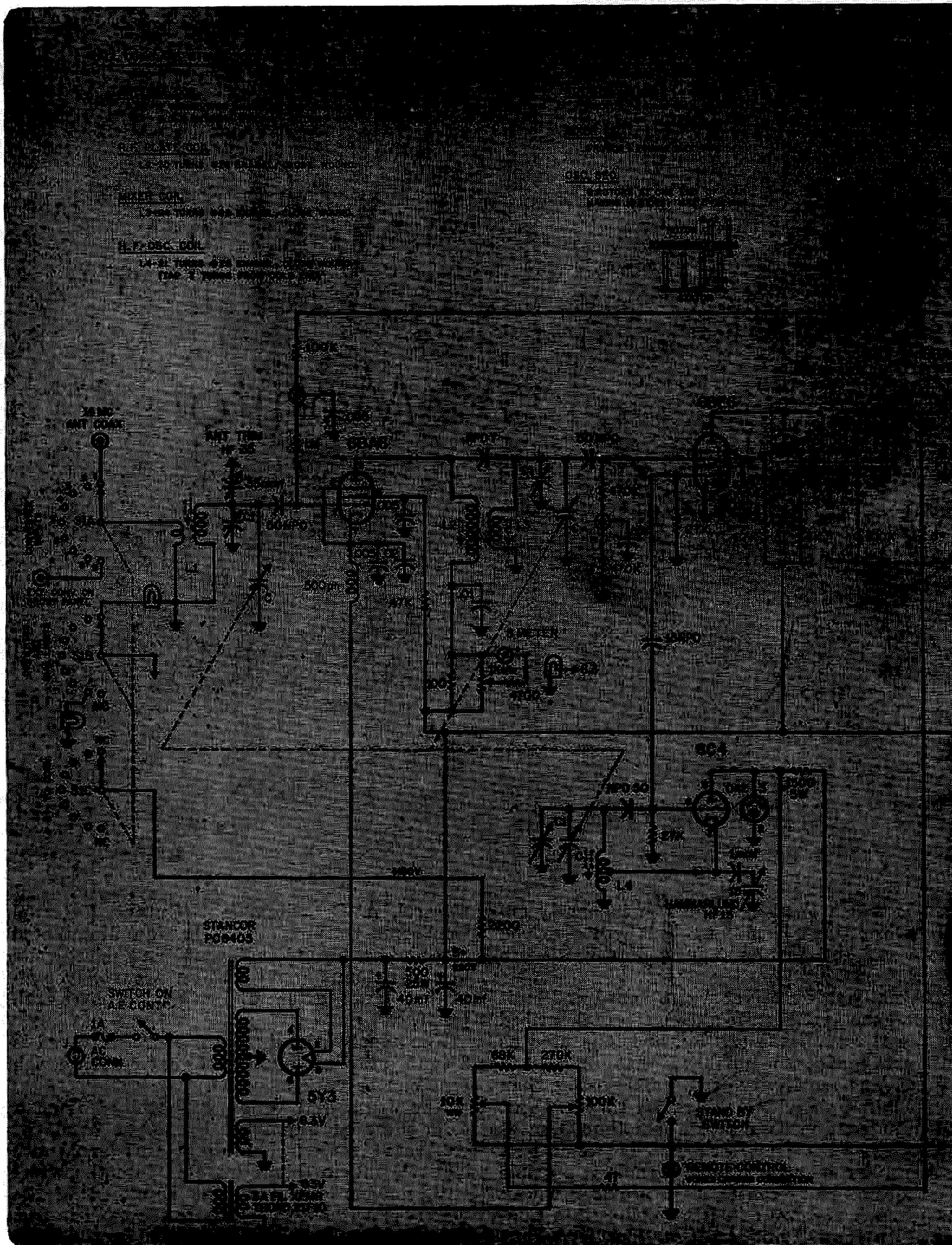
Actually this receiver was planned and built around the xtal controlled converters described in the October issue of "73" and it is used as a double conversion tunable *if* that tunes 13 to 18 mc. The sensitivity of this *if* is better than .1 microvolt on AM, stabilization time is about 10 minutes, and band width less than 3 kc at 3 db down on AM and SSB and 150 kc on FM.

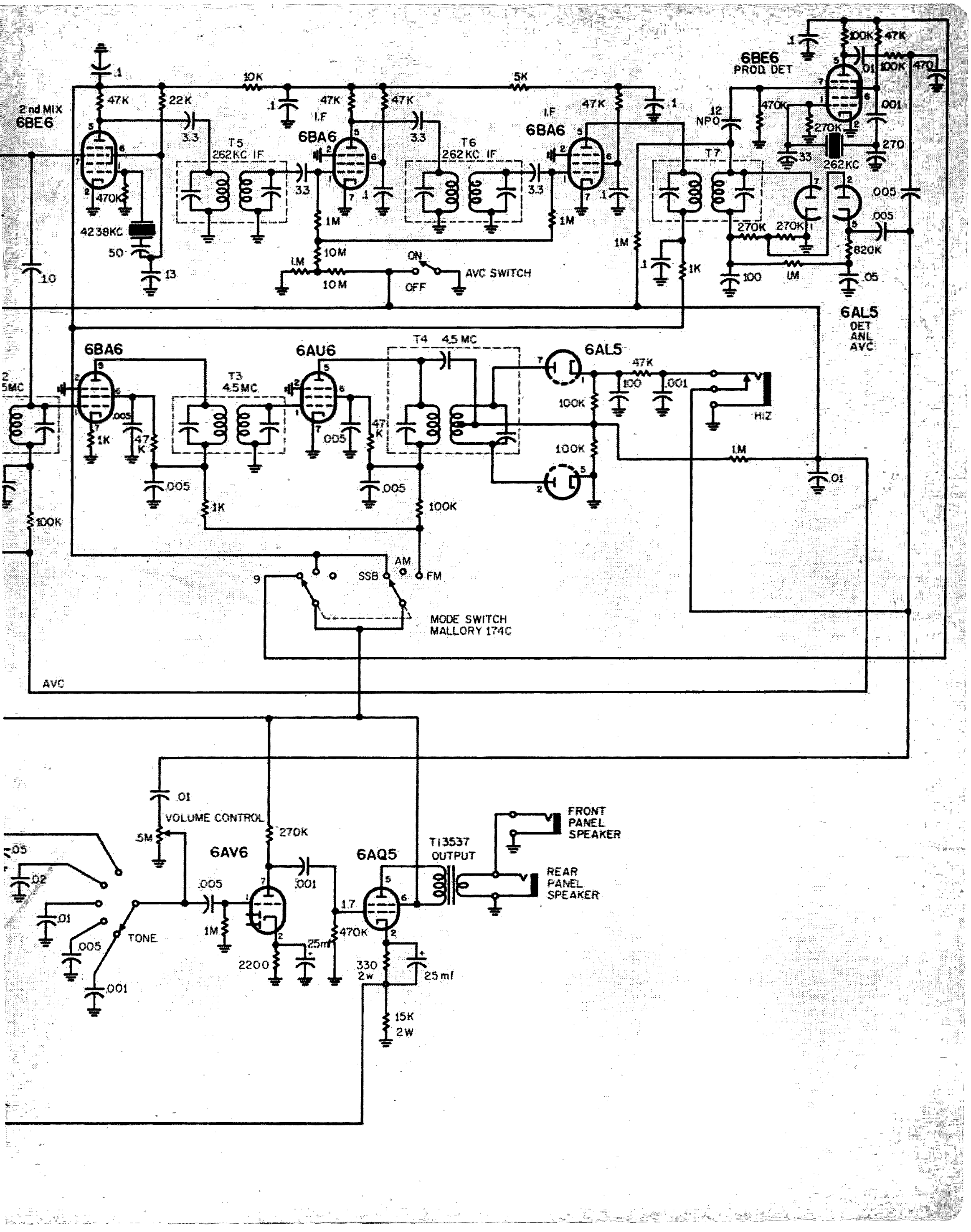
Reception of all modes of signals is possible and all necessary controls are provided within easy reach and are . . . RF and IF Gain Control, Antenna Trimmer, Osc. Vernier, Tone Control, AVC Switch, Hi-Z Output, External Converter Output, etc. It has an illuminated S-meter calibrated in S-units and micro-volts at the antenna input and an accurately calibrated large drum dial which is back-lash proof.

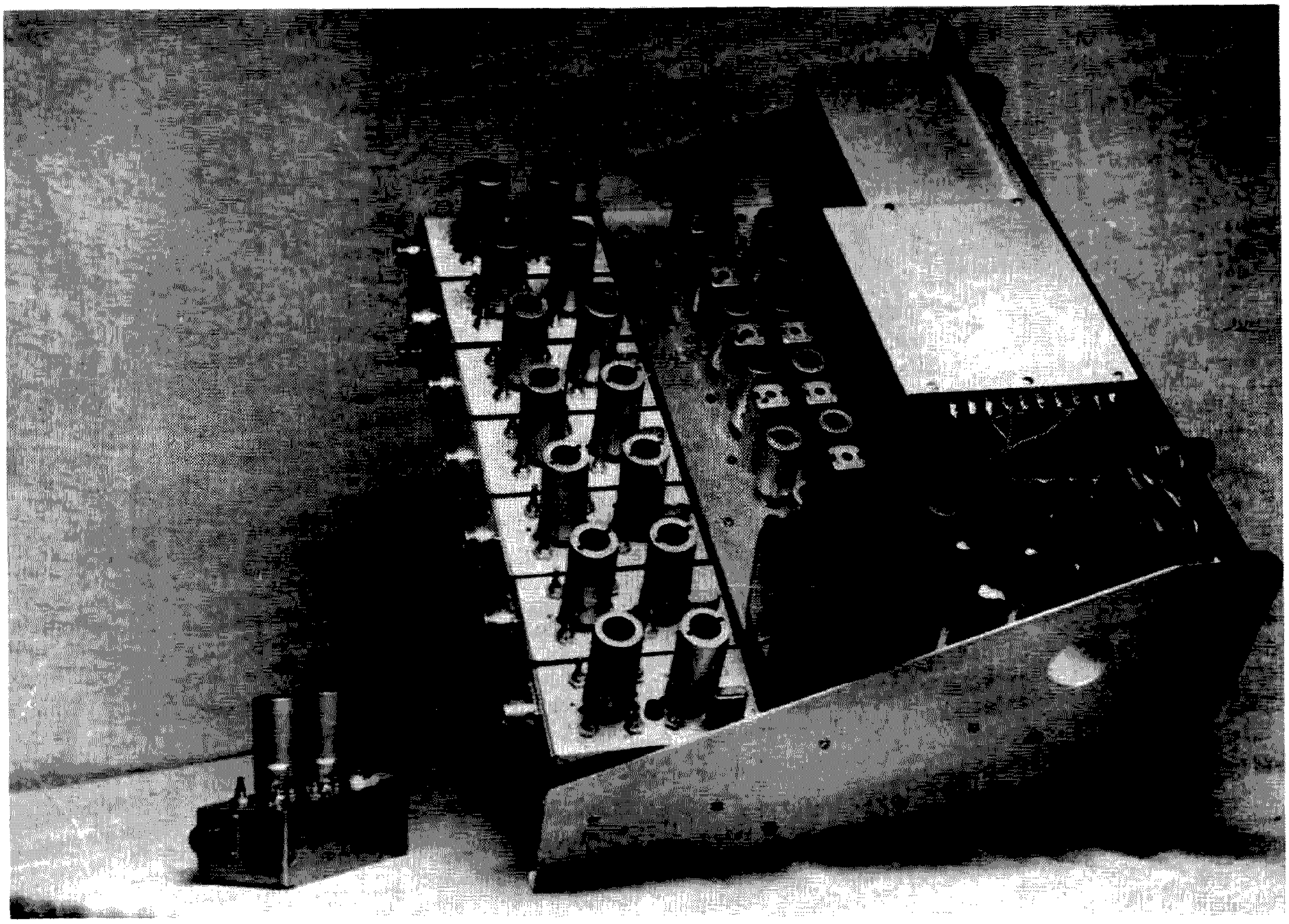
The panel with all nomenclature engraved is 8¾x19″ standard aluminum gray crackle finish that can be rack mounted.

The drum dial which is machined from a solid piece of aluminum has eight bands of calibrated scales, and above this drum are eight ¼″ lucite plugs inserted into the panel with numbers from 1 to 8 engraved in the panel below them to designate the band in use. These lucite plugs are illuminated by the same

Schematic diagram




2 nd MIX
6BE6
47K
22K
10K
5K
47K
I.F
6BA6
T5
262KC IF
T6
262KC IF
I.F
6BA6
6BE6
PROD DET
100K
47K
470
4239KC
AVC SWITCH
ON
OFF
T7
262KC
270K
820K
6AL5
DET
ANL
AVC
6BA6
T3
4.5MC
6AU6
T4
4.5 MC
6AL5
HIZ
MODE SWITCH
MALLORY 174C
SSB
AM
FM
AVC
VOLUME CONTROL
6AV6
6AQ5
T13537
OUTPUT
FRONT
PANEL
SPEAKER
REAR
PANEL
SPEAKER
TONE
330
2w
15K
2W
25 mf



pilot lights that illuminate the scale of the band in use.

The signal strength meter which is a 0 to 50 micro-amp wide view 3½" Simpson meter, is mounted upside down so that it will indicate from left to right. This meter has a hand calibrated scale made of heavy bristol board cemented to the back of the original scale, and above the meter is a meter zero control which is handy for giving true signal strength readings using zero noise reference.

The S-meter and the drum dial are framed by an escutcheon milled out of a 3"x11"x½" aluminum plate and sprayed with black crackle enamel to match the rest of the trim. In this frame a piece of ⅛" plexiglass is mounted with a fine line scribed and filled with India ink in the section of the drum dial only, and is used as a hair line for the scales.

Black handles were provided for ease of carrying the receiver, also as means of protecting the dial and knobs from damage.

Construction

It is established that no two persons will do the same job alike, therefore, just a light description covering the mechanical details will be outlined, and are as follows:

The main chassis of this receiver is shaped on a brake generally found in the sheet metal shops and is 1/16" thick aluminum formed with a ledge 1½" deep and 4½" wide on the back end of the chassis to house the seven converters. The front part of this chassis is 3½" deep with a ½" lip turned down so that it can be fastened to the front panel. The sides of the chassis also have ½" lips and are fastened to the side plates which in turn are secured to the front panel and serve as brackets. The finished chassis, as shown in the photograph, is 17" long and overall width of 13" of which 8½" is 3½" deep. All cut-outs are easily made since that type of chassis can easily be held in the vise. After the chassis is formed, tube socket holes are punched and necessary cut-outs made with a hack saw blade or a nibling tool. Upon completion, the chassis is given a lye bath and sprayed with clear acrylic (top only) for neat appearance. The dust covers over the main tuning capacitor and drum dial are also treated in the same manner.

The face of the receiver, which constitutes the panel and all necessary controls, was carefully planned and layed out so that proper function controls are at the finger-tips and the associated circuits nicely grouped for ease of wiring. While most of the components on the face of this receiver are standard, the main tuning dial knob that drives the capacitor with the attached drum was turned out on a lathe and a standard 0 to 100 division 2¾" dial was attached to it. Behind the panel of this dial is a large brass inertia fly wheel driving the main

tuning capacitor. Fast excursion from one end of the band to the other is possible by giving the dial a few spins.

The drum used as the frequency dial is machined from solid stock and is 5" in diameter and 5" long. It is secured to the end of the main tuning capacitor by a 5/16" coupling which is fastened to the 5/16" drill-rod shaft running through the drum. The drum has 2 parallel grooves and clamps to fit, so that a plastic or paper scale can easily be secured. Those that wish to duplicate the appearance of this receiver can substitute a cardboard tube or a tin coffee can for the machined drum with slight modifications.

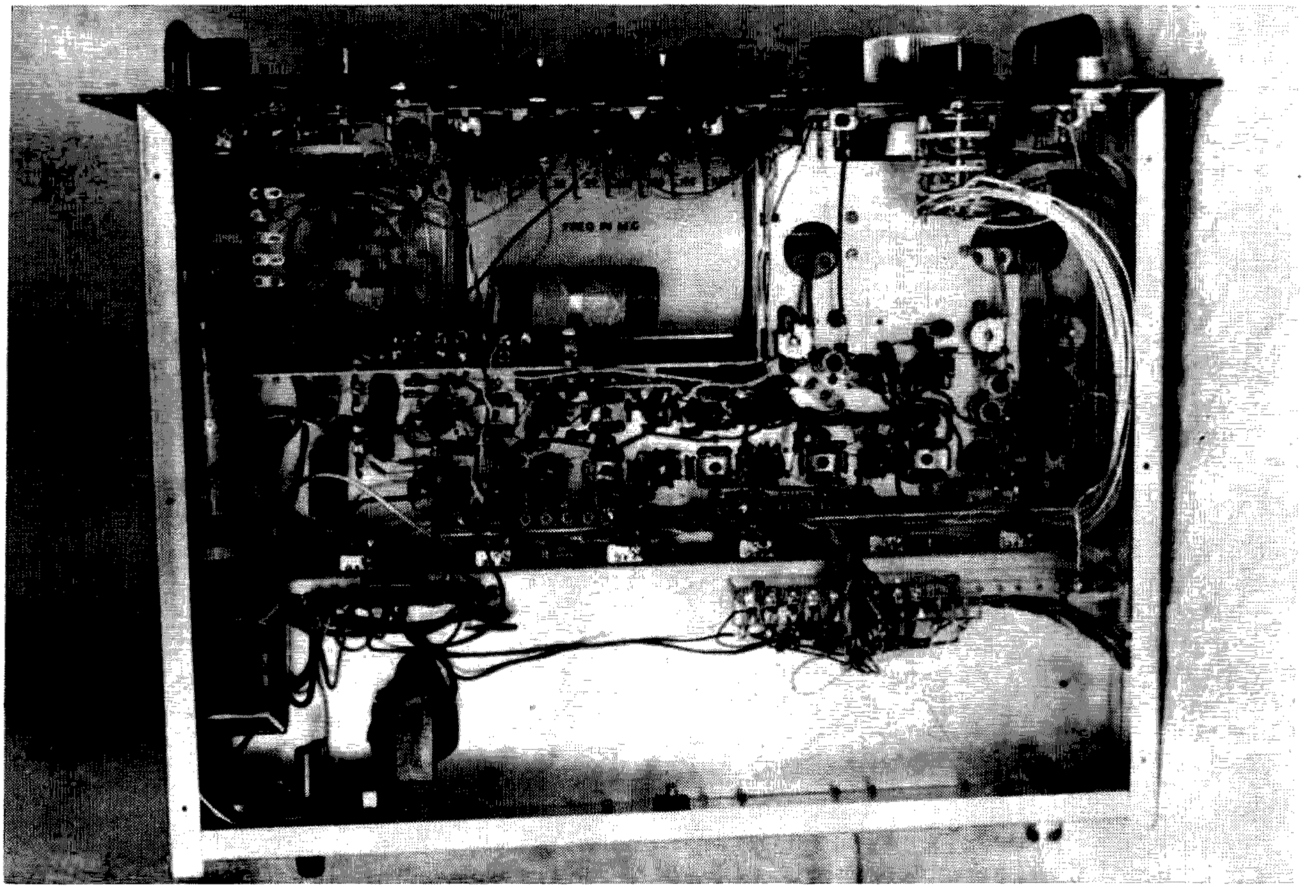
The heart of the receiver is, as usual, a good rugged tuning capacitor. This one was found in a surplus store and modified to cover the 5 mc tuning range. The only information available on this capacitor is the two numbers ink stamped, D-227464-2 and W504. The description is as follows: Three gang with right angle worm drive. A narrow drum dial about ½" wide divided into 30 divisions is mounted between the wide spaced section and the adjacent close space sections. The first close spaced section has 7 rotor and 7 stator plates, the second close space section has 6 rotor and 5 stator plates and the third section, which is double spaced, has 7 rotor and 6 stator plates. The original maximum capacities were as follows: 1st section 152 mmfd, 2nd section 115 mmfd and the double spaced section which is used as the HF oscillator tuning had 88 mmfd.

After modification, which was removing rotor plates only, the maximum capacities are as follows: First and second section 24 mmfd and osc. section 22 mmfd. This capacitor has no stop and none was provided so that continuous tuning can be achieved. The worm drive mechanism was tried for back-lash, but no noticeable effects were evident through the nicely matched and spring loaded gears.

In the event that this capacitor cannot be found, I would suggest that any three gang rugged capacitor be used by stripping rotor plates (those are easier to take off) and reducing the max. tuning capacity to around 25 mmfd. Ordinarily only 1 rotor plate will be used to get the desired 25 mmfd range. Another alternative is to use three Hammarlund MC-35S capacitors, couple them together with solid brass couplings and use a Millen No. 10012 right angle drive with a plannetary drive dial or a reduction drive mechanism Millen type 10000.

Circuits

The 6BA6 rf stage, besides being an amplifier, also doubles as a signal strength indicator by inserting a properly shunted microammeter or milliameter in the cold end of the rf coil L2 as shown in the schematic. This



stage is provided with the usual variable cathode bias to control the rf gain and has AVC applied to its grid.

The antenna trimmer capacitor which is a 35 mmfd variable is in shunt with the first section of the main tuning capacitor used to tune the grid of this stage and does a fine job of peaking.

The plate circuit is inductively coupled by L2 to L3 the signal grid of the 6BE6 first mixer. A small amount of capacity had to be added for tighter coupling due to the spacing of these coils which are independent of each other and spaced ½" on center. This is also shown in the schematic.

Test points were provided in both stages as a better means of metering during alignment of the circuits.

The tunable **oscillator** is a Hartley, using a 6C4 triode; its plate returning directly to the VR-150 regulator. No negative co-efficient capacitors were used for stabilizing since the settling time is very short due to the air trimmers, ceramic coil forms and NPO ceramic capacitors used in all rf circuits. A 15 mmfd tuning capacitor in series with a 1 mmfd ceramic is added from cathode of the oscillator to ground for fine tuning in the SSB and CW mode. A small dial is provided for it on the front panel and it is engraved "Oscillator Vernier."

The first **mixer** is a standard mixer circuit employing a 6BE6 pentagrid converter tube with a separate oscillator. The grid coil L3 in this circuit has a ceramic form and the 50 mmfd grid coupling capacitor is a ceramic NPO.

The output of the first 6BE6 mixer is fed through two stages of 4.5 mc, *if* using 6BA6 as amplifiers. The cathode of the first *if* stage is brought to a *if* gain control on the front panel, and its grid circuit tied to the AVC bus. The output of the second stage ties into the 6AU6 limiter stage; this in turn drives a 6AL5 discriminator. Negative voltage developed at the junction of the 100K resistors is fed back to the AVC line through a 1 meg isolation resistor. AVC switch is provided on the front panel to ground the AVC bus.

The output of the discriminator passes through a RC filter to a closed circuit phone jack on the front panel for HI-FI take off on FM only. This jack is engraved "HI-Z Output". From this jack audio voltage is fed to a two stage audio amplifier consisting of a 6AV6 triode section and a 6AQ5 power amplifier.

At the grid of the second 4.5 mc *if* amplifier a signal take-off through a 10 mmfd NPO capacitor is fed to the signal grid of the second 6BE6 **mixer.** This mixer uses a self contained crystal oscillator operating on a freq. of 4238 kc and converting the 4.5 mc signal to the low freq. *if* of 262 kc.

Two **low frequency** 262 kc *if* stages are used for amplification. These stages are very low noise devises due to their circuitry. As shown on the schematic, the cathodes are grounded and the plate and screen circuits operate at relatively low voltages. You will also notice that the plate and grid circuits are shunt connected and are coupled to their respective *if* transformers by 3.3 mmfd NPO ceramic capacitors.

This system proved to be very effective in reducing the noise to the minimum and not effecting the over-all amplification of the signal. The secondary of the last transformer is connected to a 6AL5 which is used as the second detector, AVC rectifier and a very simple but effective noise limiter. Here is another nice feature that readers might enjoy: the absence of ANL switch. In most cases known to the author, such a switch is always in the "on" position. By choosing the proper time constant values in the ANL circuit for a compromise of audio quality and clipping the switch was eliminated.

At the secondary of the last 262 kc *if* transformer a signal take-off through a 12 mmfd NPO ceramic capacitor is fed to the signal grid of another 6BE6 converter which is used as a product detector for SSB and a CW mixer. The ordinary tunable BFO was replaced by a crystal oscillator of 262 kc which has the advantage of stability. This feature is desirable in SSB tuning since the only drift possible is in the hf tunable oscillator, and that has been taken care of as mentioned earlier in the article.

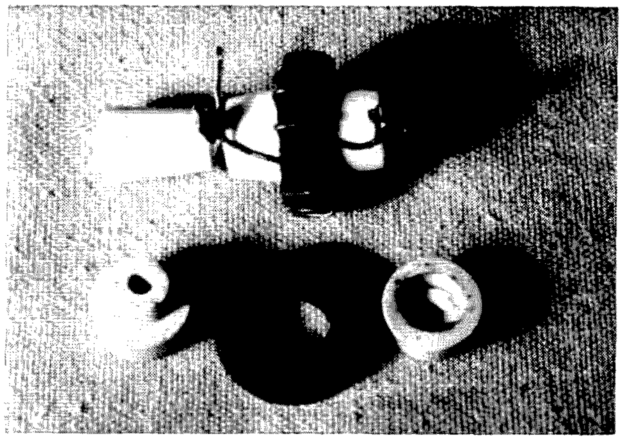
The audio from the product detector is taken off the plate through a RC filter and tied in with the AM second detector and the FM discriminator as shown on the schematics. This audio voltage is capacitively fed into the .5 meg volume control which ties also to a 5 position tone switch used for high frequency attenuation.

The output of the power amplifier transformer is coupled to two speaker phone jacks, one on the front panel and the other on the back of the chassis. The front jack is used to try out different speakers, and such an arrangement is quite handy at times.

The mode switch applies the B+ to the particular circuit in use and no unnecessary loops or feed back was encountered in this type of simple switching.

The power supply is standard full wave rectifier, well filtered producing 220 volts at 120 ma. An additional 6.3 V at 3 amp heater transformer was added to take care of the additional illumination and converters. An OA2 regulator tube supplies voltage to hf tunable oscillator and the bias for rf and *if* circuits.

In conclusion, a word about tuning might be in order. A very pronounced feature is evident during excursions of the tuning dial between signals. With the audio control set at mid point very little noise is heard in the speaker, then brace yourself when you tune across a signal. 73



Toroid Coils

Roy E. Pafenberg
P.O. Box 844
Fort Clayton, Canal Zone

Photo taken by Jim Gardner

THE USE of toroidal inductances, wound on ferrite cores, is becoming increasingly popular in critical applications where the characteristics of stability, high Q, high inductance to space ratio, low external field, lack of proximity effects and the ease of obtaining balance in tightly coupled multi-winding units are desirable. Probably the most common commercial use is in the broad band input transformer found in many TV tuners.

The ferrite core, toroidal inductor is a natural for amateur VFO use. The high Q required for such circuits as the Clapp oscillator is easily obtained in compact assemblies and, dependent on the mounting arrangement, these inductors can be made almost immune to vibration effects. Such an application is described in detail in the article, **Automatic Tracking Mobile System,** by Henry S. Keen, published in the October, 1958 issue of *Radio and Television News.*

There are many references in amateur literature regarding the use of toroid coupling transformers in high frequency crystal filters. The tight coupling that is obtainable and the degree of balance that may be achieved by the use of bifilar winding techniques ideally suit them to this application. Arnold and Allen in their article, **Some New Ideas in a Ham-Band Receiver,** published in the May, 1960 issue of *QST*, discuss the subject and point out a ready source of the high frequency toroid coil forms. As a point of interest, the use of ferrite core toroidal transformers is not limited to minute power levels. The Technical Material Corporation is using these cores in a 500 watt balun, designed to match a 50-70 ohm transmitter output to a 600 ohm balanced transmission line.

One characteristic of ferrite cored inductors that may be put to good use is that the permeability of the core, and thus the winding inductance, may be changed by flowing a modulating signal or an adjustable dc bias current through either the signal winding or a special winding added for that purpose. This technique was employed in the Ferri-Sweeper, a sweep frequency signal generator designed for the alignment of SSB filters. This instrument was originally described in the old CQ *SSB Handbook* and was expanded on in an article by Wilfred M. Scherer, W2AEF, in the November, 1957 issue of *CQ*. The concept of dc tuning, applied to the resonating of radio frequency circuits, offers unlimited possibilities. It is easy to visualize a complete multiband transmitter or communications receiver gang tuned by a single potentiometer which would vary the magnetic bias of the ferrite core inductors. This intriguing concept is described by Kulinyi, Levine and Meyer, in their article, **SSB in High Frequency Vehicular Radio,** which was published in the famous "Sideband" issue (December, 1956) of *Proceedings of the IRE.*

The advantages gained by the use of the new ferrite cores are not completely without cost. Available core materials are more or less temperature sensitive and compensation is required for critical, frequency determining applications. The techniques used in conventional circuitry are effective in the case of the ferrite cores and will not be detailed here. While the windings of a ferrite core, toroidal inductor are relatively immune to external electrostatic and electromagnetic fields, this is not true of the core proper. Care must be exercised in the placement of these inductors in relation to strong magnetic fields and critical circuits should be magnetically shielded. This requirement is easily met by the use of commercial, plated steel chassis.

One problem in the use of these inductors is the difficulty of mounting them in conformity with good construction practice. The photograph shows one method of assembling a neat, workmanlike, electrically stable and mechanically sound mounting. As shown, the mounting consists of a ceramic feed-through insulator, the center bushing of which fits snugly within the center of the wound inductor. This assembly is, in turn, secured to a small ceramic post insulator with a brass screw. The top coil terminal lug is electrically connected to the screw, while the bottom lug is insulated from the screw by the use of shoulder type fiber washers inserted between the bottom half of the feed-through insulator and the ceramic post. Use of the fiber cushion washers supplied

(Continued on page 56)

A Five-Dollar Frequency Meter

Jim Kyle K5JKX/6
1851 Stanford Ave.
Santa Susana, Calif.

WANT to measure frequency down to the last cycle per second? Or maybe find the exact resonance point of that AF filter you've just whipped together?

Here's a gadget that can help you do either of those, and more besides. RTTYers will find it handy for checking frequency shift. Experimenters can use it for measuring drift in a VFO. And you will find many uses for it, too, around your own shack.

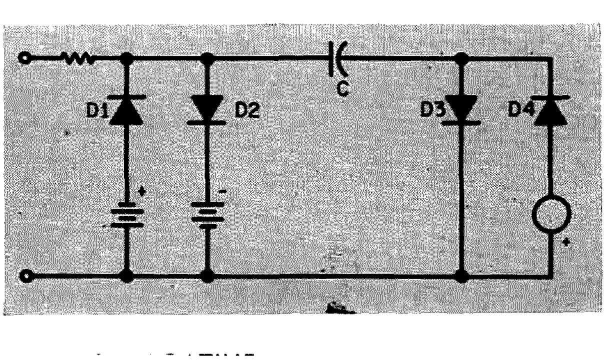
It's an audio frequency meter, costing approximately five dollars if all parts are purchased new and taking only about an hour to put together (less time than that if you're used to homebrew techniques).

While many AF frequency meters have been described in previous articles, none have all the advantages of this pocket-sized unit. Designed around the peculiar properties of most transistors, it uses only nine components (aside from range-switching circuitry), is rugged, and features high accuracy.

Before getting into the construction of the little gem, let's take a look at how it works.

The basic principles of the direct-reading audio frequency meter have been with us for at least 15 years (see the references). However, the limitations of vacuum tubes and later of vacuum-tube-directed design techniques have kept the beastie complicated enough to prevent many hams from building it.

Fig. 1—Simplified Diagram



The block diagram in Fig. 1, adapted from Terman's *Electronic and Radio Engineering*, shows the conventional circuit. Diodes D1 and D2 limit the signal to a definite peak value. Capacitor C1 differentiates the limited signal into positive- and negative-going spikes. Diode D3 shunts the negative-going spikes around the meter circuit, while D4 allows the positive-going spikes to pass through the meter. The deflection of the meter is directly proportional to the number of spikes which pass through it within a given time.

As shown, the circuit is simple enough. However, the usual input signal is small—and this circuit requires spikes some 45 volts high to give an accurate indication.

Previous designs have solved the problem by first amplifying the signal, then passing it through a limiter stage, and finally differentiating and measuring it. See any of the construction references for further details.

The five-buck special, on the other hand uses the switching properties of transistors to accomplish the same purpose.

Looking at the schematic diagram, Fig. 2 you will see that input signals go directly to the base of Q1 through the 470-ohm current limiting resistor. Normally, since the base is not forward-biased, Q1 is cut off and passes little or no current. As a result, there is no voltage drop in the 5600-ohm collector resistor and the voltage at the collector is -9 volts.

When the negative half-cycle of an input signal comes along, however, the picture changes. The negative input places forward bias on the base, and when this bias becomes large enough, the transistor switches to saturation. Resistance from collector to emitter becomes less than one ohm, and the entir

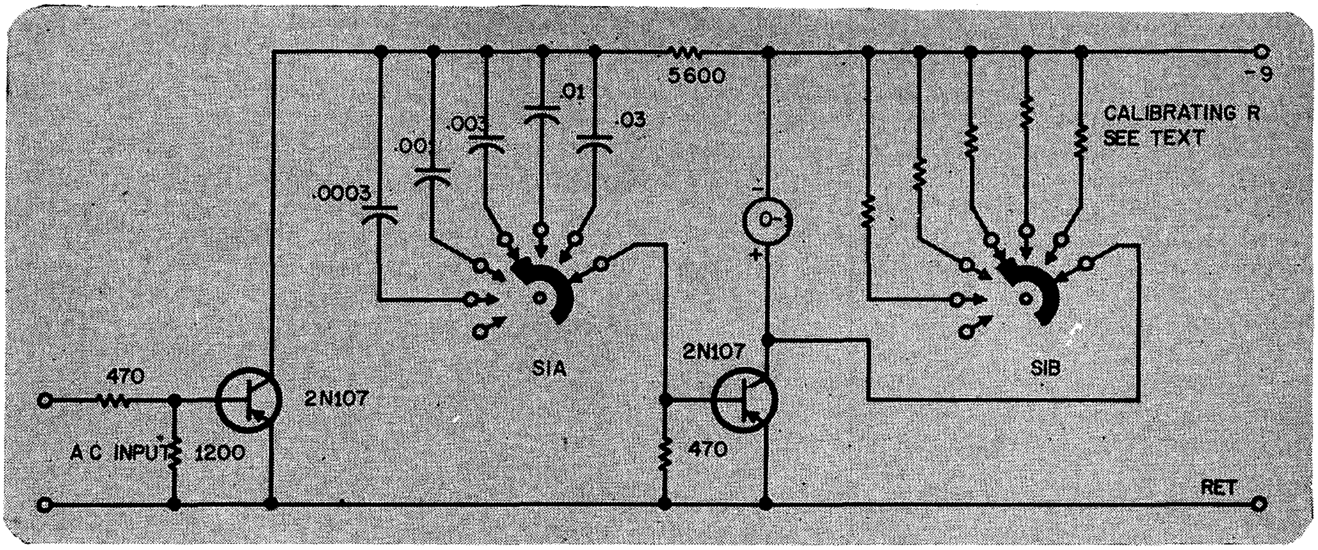


Fig. 2—This is the diagram of the deluxe model. For the five-dollar special, omit all switches and components associated with them. Connect a capacitor of proper value in place of SIA. Ranges are: OFF, 30 KC, 10 KC, 3 KC, 1 KC, and 300 CPS. Meter is 0-1 ma.

supply voltage is dropped in the collector resistor. Collector voltage drops to zero.

Approximately 0.2 volts is the crossover point for the 2N107 used in this circuit. This makes 200 millivolts the smallest signal which can be measured. Upper limit is determined by punchthrough voltage rating, and is about 10 volts for this unit.

We have seen how a square wave is developed at the collector of Q1 from a sinewave input. Now let's look at the rest of the circuit.

Capacitor C, the timing-reference unit, differentiates the square wave into spikes exactly as in previous circuits. These spikes are applied directly to the base of Q2.

Q2 also acts as a switch. Positive-going spikes simply reverse-bias the base and have no effect on the collector circuit. However, negative-going spikes turn the transistor "on" for the duration of the spike and allow pulses of current to flow through the meter.

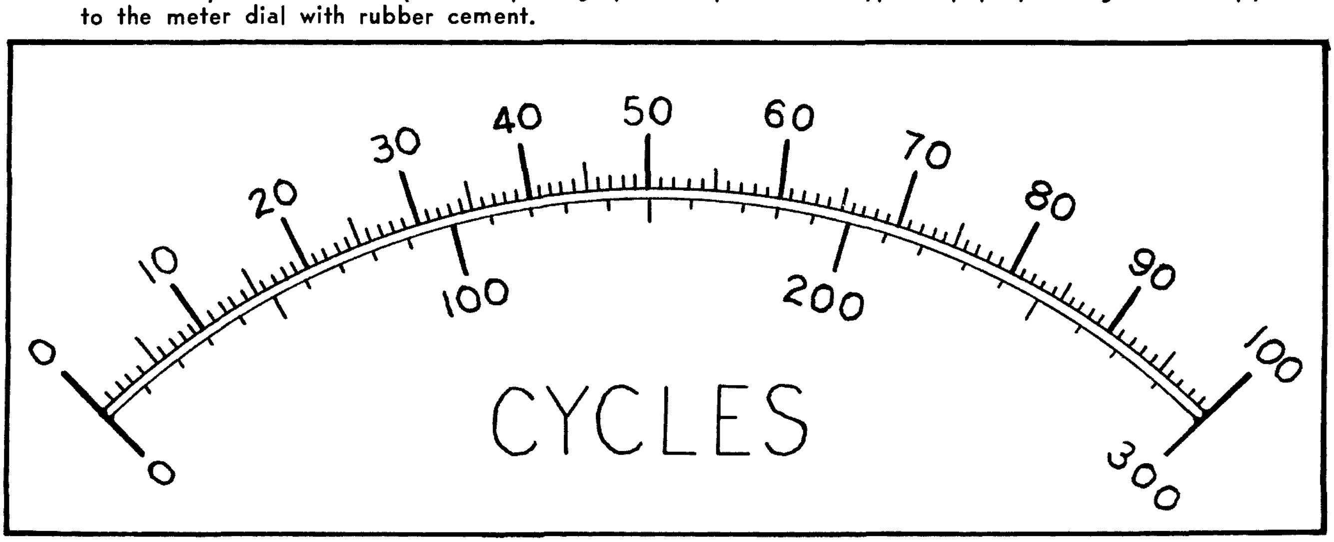
Since the amplitude of the spikes is increased through Q2's switching action, an inexpensive meter is highly satisfactory. The circuit provides linear operation up to approximately 10 milliamps current flow through the meter. Earlier designs required movements in the 1 ma to 100 microamp range for linear operation.

That's how it works. Now, to construction.

Perforated phenolic board makes a fine "chassis" for the two transistors and four resistors used. I built the prototype on a salvaged printed-circuit board given away at an electronics parts show. If you don't want to strive for the ultimate in miniaturization, use three-terminal tie points.

All the usual heat precautions applicable to any transistorized construction apply here. Leave the leads long or use long-nose pliers as a heat sink between the transistor and the solder joint. Aside from that, wiring is not critical.

Fig. 3—To dress up the frequency meter, use this meter face. Have a photocopy made in the exact size to fit your meter dial (tell the photographer to print it on Type A paper) and glue the copy to the meter dial with rubber cement.



If you're building a single-range frequency meter, timing capacitor C can be placed on the circuit board also, as can calibration resistor Rc (when its value is determined as described later). For a multi-range meter, these components should be mounted on the range switch.

Whether you are building a single-range or a multi-range meter, leave the calibration resistance out of the circuit at first. It will be permanently connected later, after its exact value is determined.

If you're building a multi-range meter, you can use the meter face shown in Fig. 3. Simply have a photocopy made, the proper size to fit your meter. For a single-range meter, pick the basic movement to show the same values as the frequency range you're interested in—that is, for a 0-3 kc meter range, use an 0-3 milliammeter, etc.

Once the meter is built, calibration comes next. WWV provides a handy source of 440- and 600-cycle tones, but be wary of frequency distortion caused by multipath transmission of the signal. A reliable 60-cycle calibration note can be obtained from the secondary of a filament transformer.

However, the method used on the original provides a number of tones in the range of interest, at very low cost. A hi-fi frequency range test record, such as those distributed by Cook Records or RCA Victor, is placed on a convenient record player and the freq meter is hooked to the speaker leads. The result is a large number of calibration points from 15 kc down to 50 cps.

Since the scale is completely linear on each range, only one calibration point per range is necessary. If all capacitors in a multi-range unit are within 1 percent of the marked value, only one calibration is necessary for the entire instrument.

However, since you can buy five 5-percent resistors far cheaper than the difference in cost between 20-percent and 1-percent capacitors in the range needed, let's use the 20-percent capacitors and calibrate each range individually. If you're building a single-range meter, simply stop when you've calibrated your single range.

To calibrate the unit, jumper in a 500-ohm rheostat across the meter using test leads. Connect the frequency meter to the calibration source you're using. Adjust the rheostat until the meter needle indicates the proper frequency (such as .6 if you're using a O-1 milliammeter for a freq meter on the O-1 kc range, with 600-cycle calibration tone).

Disconnect the rheostat without disturbing its setting and measure its resistance with an ohmmeter or bridge, if you have one. Select a ½-watt resistor with the same resistance and connect it in the unit.

Repeat this procedure for each range of the meter. That's all there is to it.

On a multi-range meter, you may find it easier to get the exact resistance value needed by connecting a number of small resistors in series. When you do this, you may be able to cut down the number of resistors used by noting the resistance necessary for each range, then making up the smallest resistance first. Add just enough to it to reach the next higher value, then enough more for the next, and so forth. Bring out taps to the range switch. A glance at Fig. 4 may make this clearer.

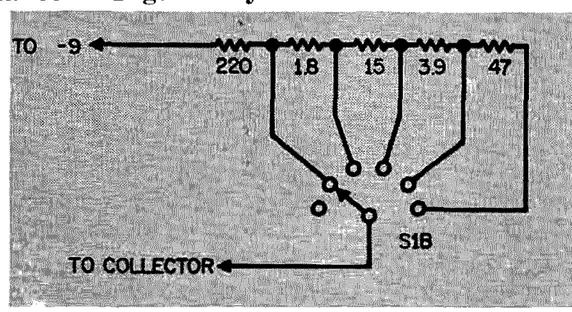


Fig. 4—Alternate calibrating-resistor circuit discussed in text. Values shown for resistors are for example only—the exact value to be used in each position must be determined after the instrument is built as described in text. In this example, position 1 gives 220 ohms; 2 gives 221.8; 3 gives 236.8; 4 gives 240.7, and 5 gives 287.7. If necessary, switch contacts can be jumpered to give identical resistances or the sequence reversed to give lower resistance on higher range.

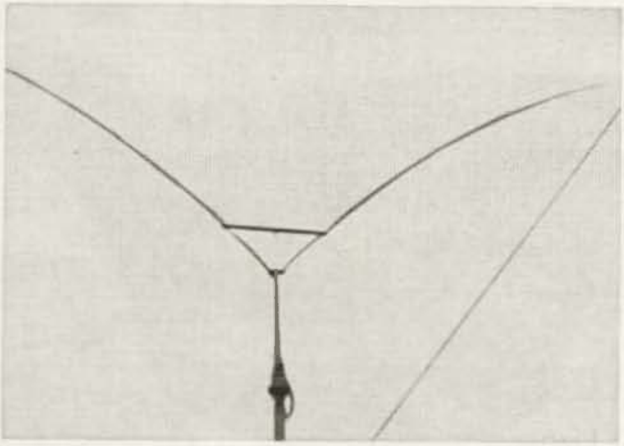
Operation of the completed and calibrated instrument is simplicity itself. Simply connect its input to the unknown signal source (making certain that no dc is present; if in doubt, use a transformer or a coupling capacitor), crank the gain up until the reading becomes steady, and read the meter.

Gain must be cranked up for this because the input transistor acts like an amplifier instead of a limiter for signals smaller than the 200-millivolt turnover point. You will also find that the reading increases as gain goes up, until it reaches a point at which it comes back down. If you increase the gain still more, the needle backs off to a point and holds steady. This is the proper indication.

Reason for the variation in reading is this: When the gadget first starts limiting the input signal, it merely clips off the top of the negative half-cycle. This produces a pulse-type output instead of a true square wave. The pulse output acts, to the meter circuit, like a combination of a high and a low frequency. The needle responds by wavering. When proper limiting level is reached, the needle is steady as a rock.

Since this frequency meter is current-operated rather than being voltage-driven, be sure the input can supply a little power. A half-watt is enough, but purely-voltage sources (such as the output of a hi-fi preamplifier) simply won't operate it, even though the volt-

(Continued on page 54)



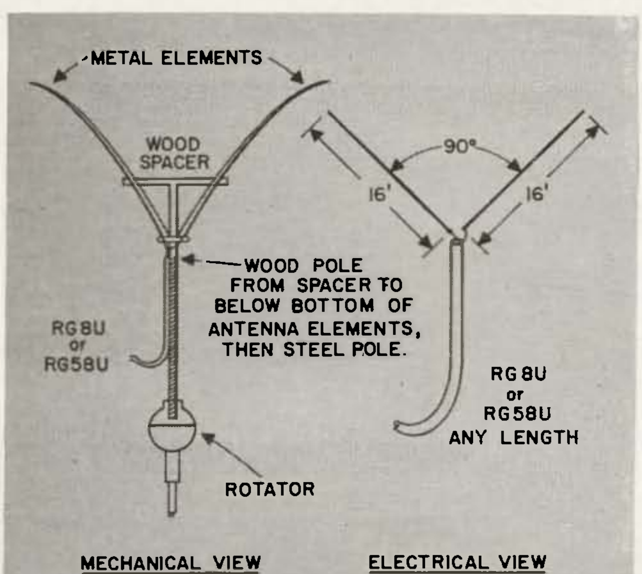
Rotary "Wabbit Ears"

W. G. Rommel, W6EHY
8508 Trask Avenue
Playa Del Rey, California

THE ANTENNA SYSTEM which you are to read about should not be considered as the answer to all problems. It was conceived with two basic thoughts in mind, and as the experiment progressed other advantages became apparent.

The first and probably uppermost in all ham minds is the space necessary to swing any type of rotating device. This has caused the recent swing to "Short and Loaded Beams," which we now see on all sides. It has long been understood that we don't get something for nothing—the short or loaded beams are no exception. To try and reduce the over-all span and yet retain the actual radiation surface was what we needed.

The second problem was one of obtaining as good a pattern as possible with some gain and front to back ratio. All of this, cheap and light at the same time, usually makes the average ham spin his sprockets rapidly. Oh yes, we would also like this gadget to match a 50 ohm coaxial line over say 300 kilocycles.



MECHANICAL VIEW ELECTRICAL VIEW

Now that we have looked the problem over, let's see what can be done. The best place to start is with our old friend the center fed dipole. Let's for the sake of simplicity, stay on 14 megacycles as we proceed. The dipole for 14 megs gives a length of 32′ give or take a few inches per your pet formula. In trying to arrange this long piece of pipe to consume less space and not fold back on itself with the resultant loss of radiation area, you are soon left with one conclusion. The ends must be moved closer together. When we do this, what happens to the antenna as a radiator and how far can one go before the whole thing falls flat on its face? By the use of a scale model and 500 megacycle rf we can find out a lot of information without driving the neighborhood crazy. The feed impedance of a center-fed half-wave dipole antenna is roughly 75 ohms. As the two quarter-wave sections are moved toward a right angle, the feed impedances drop down until, at the right angle position, the feed point becomes approximately 54 ohms. Once the right angle position is reached the feed impedance will change rather rapidly as the angle of the elements is changed a few degrees either way. The 90 degree position has an impedance which looks very happily into a piece of 50 ohm coaxial cable. Further investigation also shows the "Q" to be on the right side for good band width. We now have a full length radiator, which does not throw a shadow as large as it did at the start. We also are now in agreement with the cable which we all love to use.

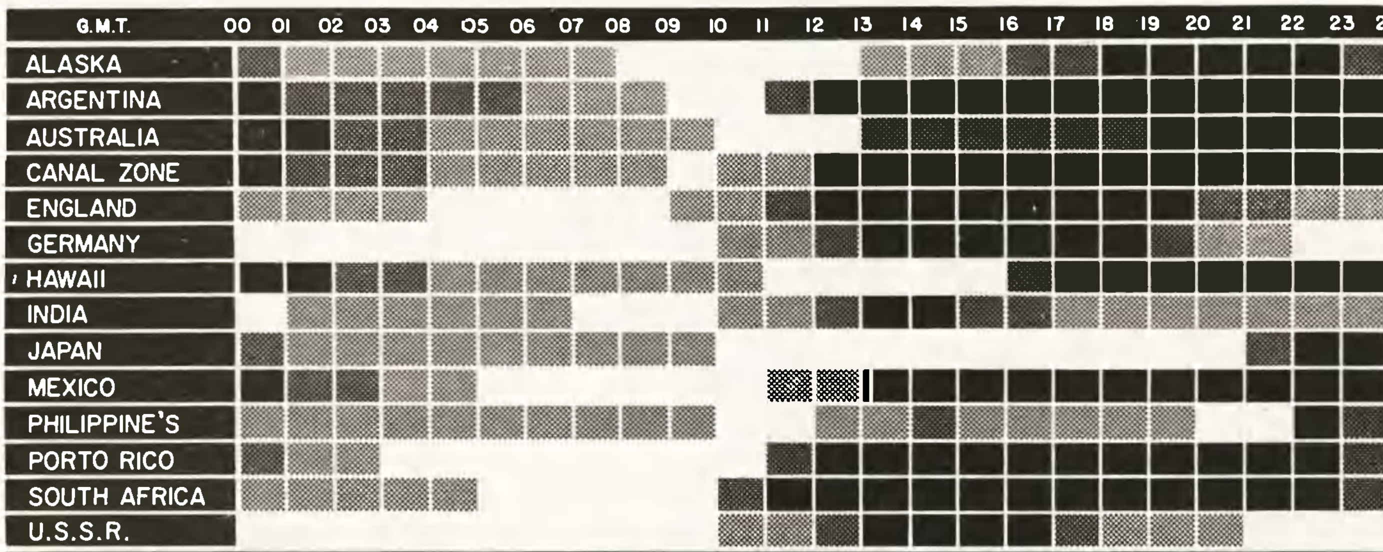
I know that at this point there are some who will want to close the angle more and reduce the shadow, but let's not push this thing too far because all you will do is make a tuned feed line with very low radiation efficiency.

Well! Now that we have this fine looking device, let's see what happens when we pump

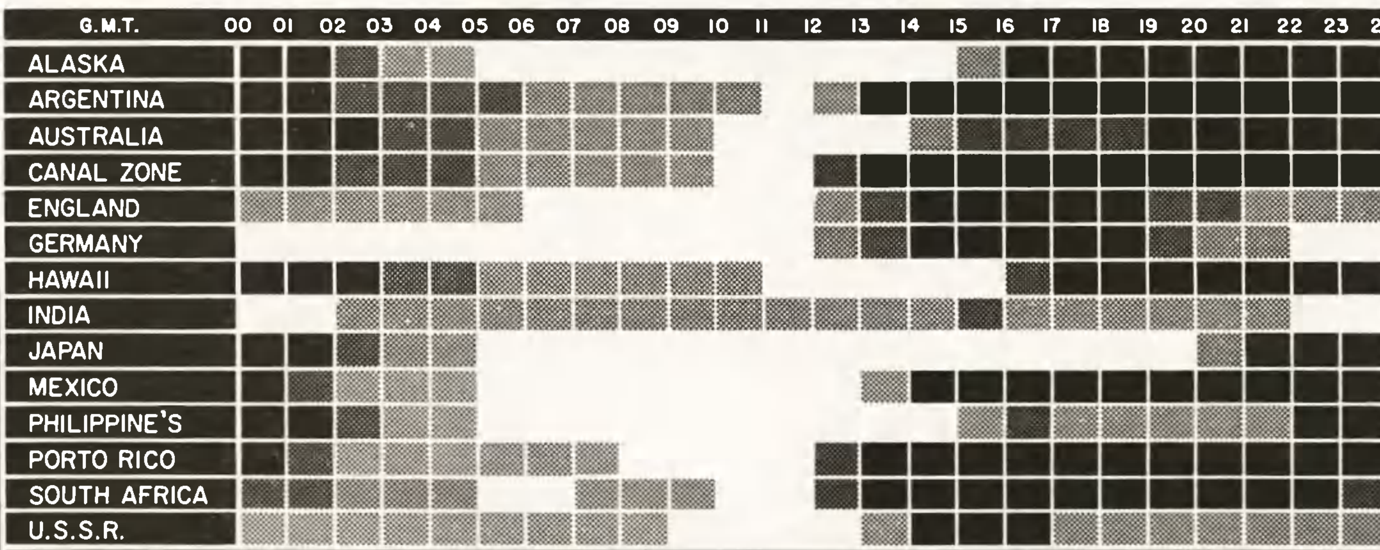
(Continued on page 57)

PROPAGATION CHART

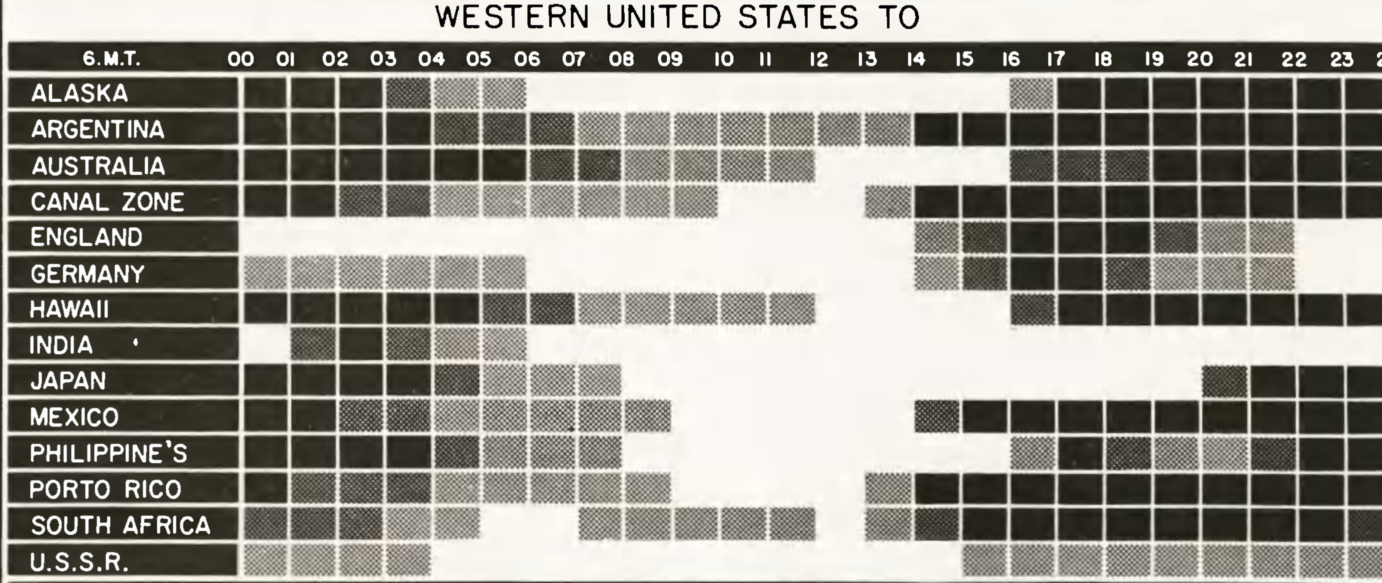
EASTERN UNITED STATES TO



CENTRAL UNITED STATES TO



WESTERN UNITED STATES TO



Propagation Charts

These charts are to be used as a guide to ham band openings for the month of November, 1960 to the various countries listed. I will be interested to hear of your results in using these charts and to know what other areas you might wish included in future charts.

David A. Brown K2IGY
60 New York Avenue
West Hempstead, N. Y.

TO HAVE reliable communications between any two points we must choose a frequency hat is low enough to be reflected from the pper layers cf the ionosphere and yet not so ɔw that ionospheric absorption makes it necssary to run excessive power. Too high a freuency, one that is above the Maximum Usable 'requency (MUF), will skip over the intended eceiving point.

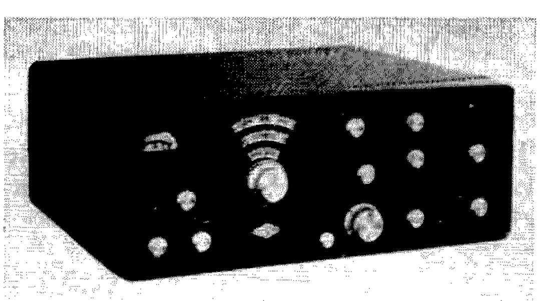
We can predict the MUF by interpretation f charts made by the National Bureau of ;tandards' Central Radio Propagation Laboraɔry. From these charts I have made up three charts covering transmission from eastern, central, and western United States to various countries. The bands listed are MUFs and a higher band will not work for the time period listed. Lower bands will work, but not nearly as well. Times are GMT, not local time. 73

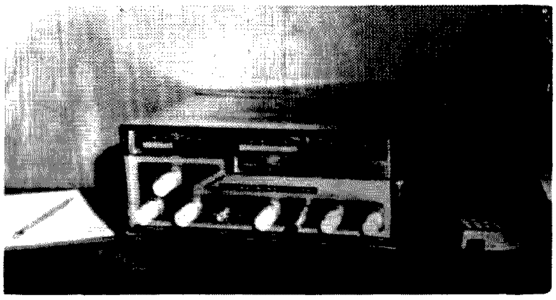
Advance Forecast: November 1960
Good: 3-4, 8-9, 18-21, 24-26, 28.
Fair: 1-2, 5-7, 10-11, 16-17, 22-23, 27, 30.
Bad: 12-15.

New Products

Gonset Transceiver

100 Watts on the hoof . . . if you happen to be ɔrse-mobile. The Gonset G-76 transceiver consists f a complete six band transmitter with 100 watts ıput and VFO controlled on all bands except six ıeters. This is 100 AM watts too. On CW it will erk at 120 watts input. The receiver is a dual conɜrsion superhet which will tune AM-CW-SSB and ɜs an ideal selectivity curve with 6 db down at 3.5 :. The sensitivity is 1 microvolt for a S/N of 6 db. 100 kc oscillator is available as an accessory. Power ıpplies are available for 117 v ac with built in ɔeaker or a 12 v dc transistor supply for the car. ze is 1 foot wide and six inches high. Great for ıe car or shack. Or both. And hey, when you write ır more details, which you **are** going to do, please ɔn't keep it a secret about this writeup being in 73. 'K? QTH is Gonset Division, Young Spring & Wire orp., 801 South Main Street, Burbank, California.





Globe Transceiver

Globe has added an interestingly styled transceiver to their fine line of ham gear. The "Mobiline Six" weighs in at only 20 pounds, including the built-in three-way power supply (115 vac, 12 vdc, 6 vdc). Size 5" x 12" x 12" is dandy for car or shack. Hmm, lessee what they say here . . . oh yes, 20 watts input to a 2E26, 7 tube receiver, squelch, stable as the dickens, VFO or Xtal control, S-meter, VFO spotting, $229.95 wired and tested. You probably want to know more about this one, don't you. DON'T YOU! OK. Write to Globe Electronics, 22-30 South 34th Street, Council Bluffs, Iowa and mark it to the attention of Howard D. Vann.

MORE NEW PRODUCTS
on Pages 24 and 50

A Critical Look at EQUIPMENT MANUALS

A. C. Peed, Jr. K2DHA
34 Ashley Drive
Rochester 20, N. Y.

LET'S FACE IT fellows—no matter how much you know about electronics and amateur radio practices, when you purchase a piece of commercial gear you need an instruction manual. It is a sort of "road map" to the location and correct use of all the fittings and controls on the unit. You'll do yourself as well as the manufacturer a big service if you'll first take the time to read the manual *before* you fire up.

But, let's take a look at the current crop of instruction manuals in the light of their use in amateur radio. Are some of the manufacturers being fair with us? Some of their manuals just don't measure up to the purpose for which they are intended.

Physical Form

First impressions are often lasting ones, and the first impression of many present-day manuals is not good. The manufacturer misses a bet for consolidating his favorable position when you open the carton and take out a shiny new piece of gear along with a flimsy instruction book. A two-bit booklet is not a fitting complement for a two- or three-hundred dollar receiver or transmitter!

The physical form of many manuals is poor. Mimeographed instructions folded haphazardly and tossed carelessly into the shipping carton often arrive at the ultimate destination after shipping, torn, frayed, and abraded beyond use. Even if they are received in good condition, after a few months of being shuffled around the bench or operating table they become dog-eared, curled, dirty, and nearly unreadable.

A good manual should have a sturdy heavy-stock cover which can be expected to protect it in normal use for a considerable length of time. Even if the nature of the gear requires that a loose-leaf approach must be taken, there are good inexpensive binders with clasp fittings which will fill the bill in protecting the contents. (If a piece of equipment is purchased which has such a flimsy manual, it is a good practice to purchase some sort of cover or folder to put it in while it is still fresh.)

Another desirable feature of manuals is a binding which will lie open (without weights) at any page in the book so that when used on the service bench it can be referred to while the hands are busy manipulating test prods or alignment tools.

While we are on the subject of physical form, wouldn't it be wonderful if all the instruction manuals were of one standard size? Even if they all fell into the two most common sizes it would help (8½ x 11-inches and 5½ x 8½-inches). But there are always a number of odd sizes and shapes which persist in becoming lost in any bookshelf or file drawer.

Schematics should be large enough to be readable from workbench reading distance, and if they are large they should be bound into the manual in the form of gatefolds which place the entire schematic outside the book when unfolded. This means that the first fold out from the binding should be the left edge of the diagram. (The part of the gatefold which is inside the book can be used for some other purpose such as parts list, tube location diagram, etc.) When schematics are supplie in this fashion, they are fully accessible alongside any page of the text which is of interes with any particular problem. If schematics are supplied loose (not bound-in), a pocket shoul be provided to hold them in the manual.

Manuals should be illustrated. It takes som very labored text entailing careful reading t describe the location of many components an adjustments which can be shown very simpl and directly with a good well-reproduce photograph or drawing properly labeled.

The typography and layout in manual should be open in character and nicely broke up with white space, illustrations, and subheads. Nothing is more deadly and uninviting than solid pages of unbroken text, especiall if it is set in small-sized type closely spaced. It takes a dedicated and determined reader to even attempt to wade into it. And yet, this is a very popular style among manuals—probably on the theory that if a manual has to be provided, all of the essential informatio should be crammed into the minimum spac possible to hold down the printing costs.

Manual Organization

The ideal manual should be organized t make it most serviceable. In the case of manuals for amateur radio equipment, the following organization seems appropriate.

First, a brief table of contents, so that the organization of the manual can be quickly ascertained and any section located without having to thumb through the whole book. (An instruction book of over about 8-pages in length should have a table of contents.)

The first section of the text should detai briefly and clearly how the unit is to be installed, calibrated, and tested. After all, who can resist putting a new piece of equipment in service as soon as possible to see how it is going to work? The maker should tell you how

ATTENTION HAMS!

ARROW ELECTRONICS, INC.

ONE OF YOUR MAIN SUPPLIERS OF AMATEUR RADIO GEAR POINTS WITH PRIDE TO THESE IMPORTANT FACTS:

LOOK TO ARROW AS YOUR ONE SOURCE OF A COMPLETE LINE OF ELECTRONIC PARTS AND EQUIPMENT TO SATISFY ALL YOUR NEEDS.

COME AND BROWSE AROUND OUR LARGE AND FULLY STOCKED SHOWROOM WHERE YOU'LL FIND THE LATEST IN HAM GEAR ON DISPLAY. YOU'LL LOVE IT!

MAIL ORDERS PROMPTLY PROCESSED • SAME DAY SHIPMENT FROM STOCK
WRITE FOR FREE CATALOG

ARROW ELECTRONICS, INC.

65 Cortlandt Street, New York 7, N. Y. • DIgby 9-4730
525 Jericho Turnpike, Mineola, N. Y. • PIoneer 6-8686

to do this quickly, but in a safe and sane fashion. And, in this same section all of the safety precautions should be strongly emphasized. This means those precautions which should be taken for the operator's protection as well as those which will prevent damage to the equipment through misuse.

If the gear in question is to work with interconnections to other pieces of equipment, these should be detailed separately according to the possibilities. If designed to work with several different makes of auxiliary equipment, list the interconnections separately. All of the possibilities should not be covered in one section full of "if's" and "or's" and other modifications of the instructions according to which brand of auxiliary equipment is to be used. In other words, all of the necessary instructions for connection to Brand X should be covered in a paragraph, then Brand Y, Brand Z, etc.

Even if the manufacturer has made this piece of equipment specifically to work with another piece of gear of the same brand, it should be recognized in the manual that it is possible that the purchaser will be using it with competitive equipment, and instructions given accordingly. Simply refusing to state that the unit will work with auxiliary equipment of competitive manufacturer won't help the sales of anybody's products. If Brand X sideband generator can be used with Brand Y transmitter the manual should say so and detail how, and we'll all benefit—manufacturers and consumers alike.

The next section of the text is one that is of great importance and yet one that is too seldom seen in manuals. This section should cover the "philosophy of the design". It should be written in more leisurely essay style than section one and be designed for careful reading by the owner after he has worked off his initial burst of enthusiasm to try out the lash-up. He is then ready to learn some of the fine details of his new purchase, and he is in a very receptive mood for them. He has purchased this particular piece of equipment on the basis of advertising, dealer demonstrations, and his own assessment of how it compares with competitive offerings of the same general type. He has decided which offers him the most satisfaction for his investment, and he has backed this decision by putting up the purchase price. Under a similar set of motivations, others have decided on other brands of equipment, and it is the nature of amateur radio operators to expect that each new owner is going to have to defend his choice on the air and at local radio club meetings. So, he is going to be looking for information and the maker should arm him with sufficient data to make the defense easy.

The manufacturer must realize that the average amateur of today could probably design and build a pretty good receiver or transmitter if he had the time and shop facilities Hence, he can be expected to understand an appreciate a good bit of commercial design i it is described to him. Amateur gear is no like washing machines with which it is suffi cient to inform the user which buttons are t be pushed to perform a washing—as long as satisfactory wash job comes out the consume will be happy and not give a hoot what goe on inside the machine. No *good* amateur op erator should be content merely to assess th output of his rig without knowing what i behind the panels.

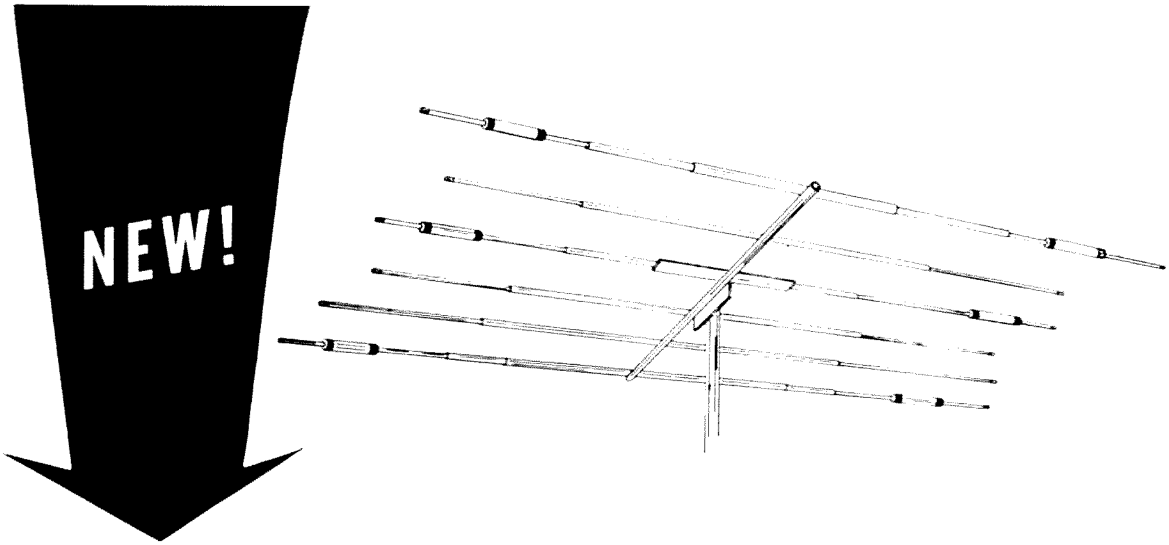
So, this second section of the manual shoul describe the design from the ground up—stag by stage. Why were the particular tub chosen? Why this circuit configuration rathe than some other? What are the unusual fea tures of each circuit? What are the critica components and how were they chosen an tested?

There is a plus in this for the manufacture A fully informed customer is more likely to b able to understand the operation of his equi ment and its service and maintenance prol lems. Hence, fewer letters of inquiry and con plaint, and fewer trivial service problems. I other words, more satisfied customers.

The last section of the manual should co tain complete and detailed service and realig ment information. Admittedly, the purchase will probably only glance at this, but it wi give him a secure feeling to know that he ha a full treatment on service available again the time when it may be required urgently keep him on the air.

Again amateur equipment differs from wash ing machines. It is easier to find a compete local washing machine repairman than it a serviceman for an ailing communicatio receiver or transmitter even in a fairly lar city. So, Mr. Average Ham in small to mediu sized communities has to take on his own se vice in most cases, or submit his gear to t tender mercies (?) of the express compa for an expensive trip to the manufacturer service shop. Yet, Mr. Ham is supposed to an electronics expert of some degree, and giv a good service manual he can probably ta care of most of his troubles himself.

In preparing the service section, the man facturer should bear in mind that the ind vidual who may be using this informati probably doesn't work full time at electron service. So, the test equipment and test pr cedures should be detailed more than in manual intended expressly for servicemen. F servicemen, it is adequate to tabulate alig ment frequencies and the adjustments whi are to be made. For the amateur, these shou be spelled-out with full information as where to inject the signal, the type of sign (frequency, modulation, amplitude), where read-out the alignment indication, etc. The fu time serviceman can be assumed to know the



TA-36 by Mosley

for 10 • 15 • 20

The new clean-line design TA-36 . . . the three band beam that will give your signal that DX punch!

This wide spaced, six element configuration employs

4 Operating Elements on 10 Meters
3 Operating Elements on 15 Meters
3 Operating Elements on 20 Meters

Automatic bandswitching is accomplished by means of exclusive design high impedance, parallel resonant "trap circuits". Built for operation at maximum legal amateur power. Low SWR with high gain and front-to-back ratio. Traps are weather and dirt proof offering frequency stability under all weather conditions.

All heavy wall 6061-T6 aluminum - the finest aluminum alloy for antenna construction! Boom measures 2" OD by 24' by 1/8" wall, elements measure 1 1/8" to 5/8" in diameter with center sections of double thickness aluminum to reduce sag . . . fully rust and corrosion proof - Guaranteed!

Before you buy *any* beam - *Check Construction Features!*

See your nearest amateur equipment dealer or write for literature describing the TA-36 . . . the newest member of the Mosley TrapMaster family of fine amateur antennas.

Amateur Net $129.50

Mosley Electronics, Inc. 4610 N. LINDBERGH BLVD.
BRIDGETON, MISSOURI

WEST COAST BRANCH
1406-08 South Grand Avenue
Los Angeles 15, California

INTERNATIONAL DIVISION
15 Moore Street
New York 4, New York

things, but not the average ham doing an alignment on the kitchen table with borrowed test equipment.

Style

The writing style of a manual for amateur radio equipment should be light and fairly easy reading. Amateur radio is a hobby and supposed to be recreational. Many amateurs have to wade through stodgy, ponderous technical matter all day in earning their daily bread. They shouldn't have to do the same thing with their hobby. Manuals can be written in a reasonably lucid and interesting style without sacrificing their utility.

In the ideal manual outlined in this article, the first section, on installation and adjustment, should be in a brief, succinct outline style which will entail the least study to put the equipment in service efficiently.

Section two discussing the design and operational features should be in a more complete essay form much like the New Apparatus features in the amateur magazines. This can be a rather casual style minimizing design formulas and mathematics. The reader will be willing to assume that the designer has performed the mathematics and data evaluations properly without going through them in the text.

Section three on service should be full service information in a detailed and straightforward fashion. It need not be styled for complete reading at one sitting as with section two. Instead, it should consist of capsule sections covering completely in themselves one facet of the service. In this section, the manufacturer should be frank and candid about service problems which he may anticipate with this gear on the basis of his previous experience or a projection of his knowledge of this particular circuit. Points of likely breakdown should be enumerated along with the operating symptoms of such breakdowns, and procedures for locating the fault and repairing it.

Finally, the matter of parts lists: A parts list is not much use to the individual owner if it lists the parts only by the manufacturer's stock numbers. Admittedly some of the components will be specially fabricated or selected for the circuit and these it will be necessary to obtain from the manufacturer's parts department. But, there is no need to have to order common values of resistors and capacitors from the manufacturer when they can be obtained locally. The parts list should therefore contain, in addition to the stock number, a description sufficient to allow local procurement of a replacement. And, if the component is special for some reason and should be obtained only from the manufacturer, the parts list should point this out.

Manuals should not be a hastily composed after-thought. Many manuals appear to have been written by the project engineer after he finished the design and passed it on to the production department and was contemplating a well-earned fishing trip. His boss says, "Oh yes, before you leave, you'd better whip out a manual." Manuals should be written by professional technical writers with the help of the engineers and service people. Rarely does a good engineer have the heart for a writing job, and even more rarely does he have the talent and experience. The small manufacturer may say that he can't afford a full-time manual writer, but this is no excuse because there are professional technical writing firms as well as many free-lance technical writers eager to undertake such projects.

At the opposite extreme, there are the large manufacturers who do a great deal of government contract work and have full-time manuals departments. It is natural to throw manuals for their amateur line into the same mill. From the amateur's viewpoint, what comes out can be pretty ghastly! Manuals written to military specifications are too formal and ponderous for the average ham, and will be largely ignored because they are such heavy reading.

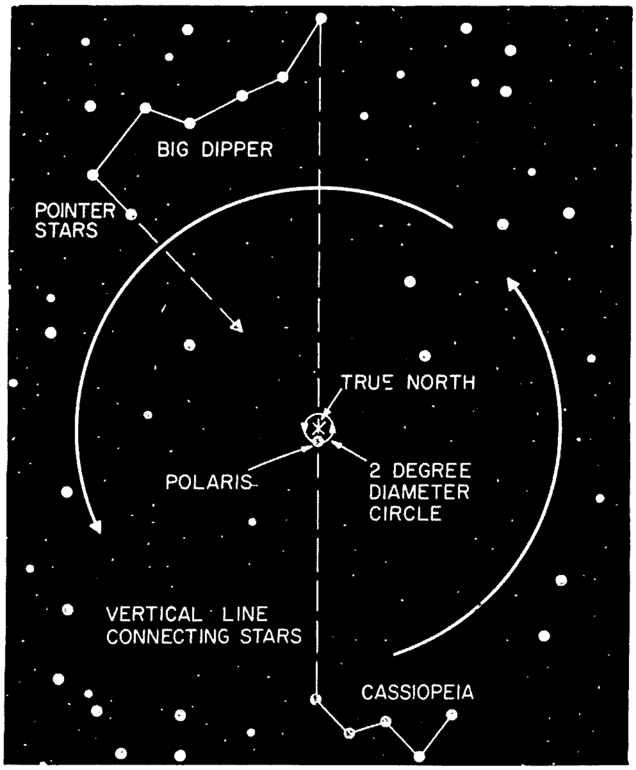
What You Can Do

The next time you consider purchasing a piece of commercial gear take a critical look at the manual. Does it measure up to the job that it must do for you? It is as much a part of your purchase as the tubes in the equipment. Both the equipment *and* the manual should be attractive, sturdy, and serviceable. If the manufacturer has slighted his duty to you on the manual, you are being short-changed.

As a practicing consumer of amateur equipment you can do something about manuals. If you don't like the ones that you receive, tell the manufacturer. Maybe he'll do something about it the next time around. Because no complaints are heard many concerns feel that they must be doing a satisfactory job.

Be fair to the manufacturer (and yourself), read the manual. Keep it in a secure place where it can be located on short notice. Refer to it when you have a question *before* you write a letter of inquiry. Fully half the letters received by equipment manufacturers ask questions which are already answered in their manuals.

The manufacturer who supplies manuals of sketchy content and indifferent make-up is missing a wonderful opportunity to consolidate his position as "most favored brand" in the minds of his customers. Well-done manuals are an excellent form of institutional advertising for building up the corporate image in the purchaser's subconscious. The customer may buy another piece of gear in the future. If he is satisfied with all aspects of his future. purchase, he can be expected to consider favorably the same brand again. If not, he will buy almost any other brand in a conscious attempt to avoid the brand with which he was dissatisfied. •



Constellations as they appear around 2100 local time in June. Note 2 deg. diameter circle described by Polaris as earth rotates about True North. True North is one deg. from Polaris

Finding True North

Calvin R. Graf, W5LFM
207 Addax Drive
San Antonio 1, Texas

JUST about all amateur radio operators and astronomers know that Polaris, the North Star, is near the point of True North. But just how close is it to this exact point and how can True North be found from Polaris?

Specifically, Polaris is almost one degree (55.4 minutes of arc) away from true north and as such describes a circle of two degrees diameter as the earth rotates once each 24 hours. Anyone interested in aligning a high gain antenna or telescope must know how to make corrections to align their instrument to the true point.

Figure 1 is a sketch which shows a line connecting the constellations Ursa Major (Big Dipper) and Cassiopeia and which passes through Polaris, the first star in the handle of the Little Dipper.

The line connects the first star in the handle of the Big Dipper and the first star in Cassiopeia. The important point to note is that True North lies one degree (55.4 min.) from Polaris *toward* the Big Dipper (or away from Cassiopeia). True North must then be transferred to a ground base line by means of a surveyors transit for use with antennas which rotate in azimuth only.

While the Big Dipper is quite well known, Cassiopeia has not enjoyed this popularity except with radio astronomers who know Cassiopeia A as a source of intense radio noise. During early winter nights, Cassiopeia appears as an M and in summer as a W.

The Big Dipper and Cassiopeia will be above the northern hemisphere horizon only during certain hours and certain months of the year. The easiest corrections can be made when the connecting line lies horizontal or vertical. Some time during the night, regardless of the season, the Big Dipper or Cassiopeia will form a straight vertical line with Polaris. This happens around 2100 local time in early June and 2100 local time in December.

In June the correction is one degree from Polaris *toward* the Big Dipper. In December the correction is one degree from Polaris *away* from Cassiopeia. In both cases the correction is in a vertical line. Correction at other times (and therefore angles) when the line is not vertical is more difficult because of the gyrating action of Polaris. Using this method, True North can be found within a few tenths of a degree of arc. 73

Letters to the Editor

Dear Wayne,

I won't take up your time with a lot of idle chit-chat. I just wanted to let you know that I am delighted with the first issue of "73".

There are many things I like about the new mag, but I will mention only a few. First off, the first thing I noticed was that it took me nearly as long to read as the famous "giant-sized" ham mag and the New York "middle-sized" thing. I guess that must prove something about ratios of advertising to solid content.

I also like the white space ratio. Your magazine is undoubtedly the easiest on the eyes of any I've read. Your circuit diagrams are also easy on the eyes and lesss confusing to boot. The three shade color selective scheme makes it easy to study the circuit without being distracted and confused by the dimensions and part values and vice versa.

Another thing I like is the propagation chart. It is simple, clear, and easy to read. That is very important in a ham magazine because very few of us are in need of charts which go into such detail that they could almost be used "as is" by commercial point-to-point stations.

Keep up the good work, Wayne. You've got an excellent magazine started here—one which, if given a good chance, may well produce some interesting changes in the circulation "standings" in the ham magazine field. I certainly hope so.

Jim Grubs, W8GRT/K9HBV
Toledo 13, Ohio

Dear Wayne,

Glad to see you back in business: you seem to have the insight into what the thinking ham needs in editorials, articles, and last but not least, your humor. Don't ever lose that. I have loads of other comments but hate to write so just remember I am delighted to have you back.

Gilbert Loescher K2QOJ
Buffalo, New York

Lieber Fuhrer:

Qualified congratulations on issue #1! Well, as a subscriber I qualify, don't I? Relative ratings volunteered below—but bear in mind most of my relatives can't read.

Best in category A—Campbell W2ZGU.

Best in category B—Kyle K5JKX/6.

Best in category C—The rest. Prizes for everybody.

You title the categories. "Literary" "Technical" etc. sound so corny. Especially "etc."

Best in category D—Kennedy's demonstration that Nixon has been operating outside the amateur bands.

Stop nagging me; I'm trying. Tore up several efforts—they simply weren't the beautifully evocative gems I demand of myself. Mustn't compromise, what? Cheerio,

Ken Cole W7IDF
The Vapours
Vashon, Wash.

Dear Editor,

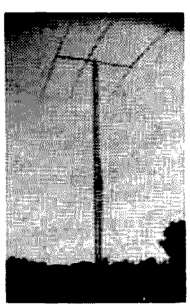
This is the first letter to any editor I've ever written, but I couldn't resist. On page 28 of 73 (which my OM, K2OYW just brought home today) there is an article on shock by Peggy Bates.

There is another method of artificial respiration that has received official recognition and widespread publicity lately, namely mouth to mouth. It is extremely easy to perform and lends itself to oddball situations, like the tops of poles, for application. . . . There is an excellent film, "Rescue Breathing" demonstrating this procedure. I can't recall who puts it out, but here in the Camden area the State Police from the Hammonton Barracks will travel any reasonable distance to show it. . . . Immediate and continued application of an easy, efficient method of artificial respiration may save lives.

Marlene Denber, R.N.
Barrington, N.J.

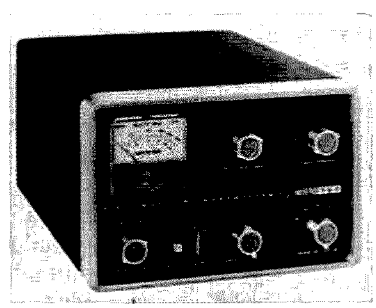
Well Marlene, Peggy Bates was a staunch advocate of the mouth-to-mouth method of artificial respiration for drowning, but when she researched for the 73 article she found that the older methods had advantages. The M2M system is not as effective in circulating the blood due to the nerve paralyzation which accompanies electrical shock.

New Products



Rohn has a new tower for you fellows who are getting a little lazy about climbing up the tower every time the rotator needs some attention or who balk at lowering the beam every time you want to make an adjustment. It's triangular, $12\frac{1}{2}''$ on a side, comes in 10' sections and will go up to 70'. The kit includes (yes . . . kit, did you expect it to come already assembled?) the boom, cable, windlass and special hinged section. May we suggest that you write Rohn at 6718 West Plank Road, Peoria, Illinois for details. You already know about telling 'em it was in 73.

This new EICO 60 watt CW transmitter, weighing in at only 15 pounds, should be of considerable interest. It covers ten through eighty meters, bandswitching, and comes either wired at $79.95 or in kit form for only $49.95. There is a provision for plugging in a modulator, VFO, antenna relay, etc. Size is 6" high, $8\frac{1}{2}''$ wide, 9" deep. Write EICO, 33-00 Northern Blvd., Long Island City, N. Y. and ask for details on their Model 723.



SOLAR SYSTEM VI

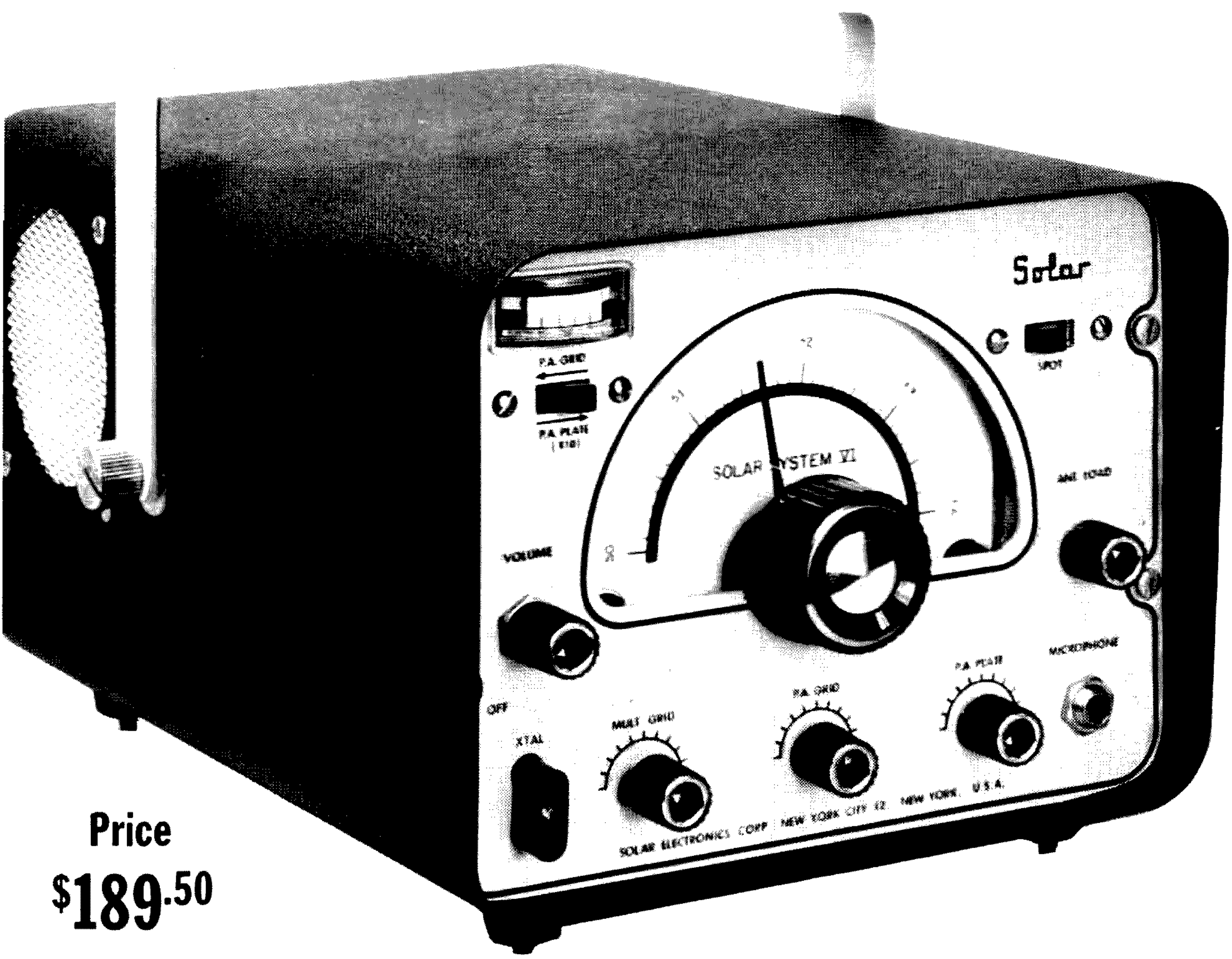
SIX METER TRANSCEIVER

RECEIVER

etter than $1/2$ microvolt sensitivity.
) kc selectivity (6 db down).
ouble conversion for selectivity, image rejection.
oltage regulated oscillators for stability.
p to 5 watts audio output for external speaker.
elf contained speaker.
arge 6:1 vernier dial for easy tuning.
ack for headset output.
uilt-in noise limiter.
potting switch for zeroing receiver and transmitter.

TRANSMITTER

12 Watts input to a 5763.
High efficiency plate and screen modulation for maximum "punch."
Uses popular and inexpensive 8 mc crystals (FT-243 holders).
Provision for VFO operation.
Press-to-talk.
Metered.
Microphone: crystal, ceramic or carbon
50-75 ohm output (will match standard auto receiving whip).



Price
$189.50

SOLAR ELECTRONICS

**Corp. 149 Wooster Street
New York 12, New York**

Other Ham Publications

RATHER than devote half or more of 73 to the printing of news of interest to specialized groups we believe that it is our function to do everything possible to encourage the publishers of bulletins which cater to these interests. These bulletins bring you the news you want in far greater detail and in much less time than is possible in a monthly magazine where it usually takes two months for news to get into print.

HAM-SWAP. Published by Ham-Swap, Inc., 35 East Wacker Drive, Chicago 1, Illinois. Editor is Ed Shuey, K9BDK. Subs are $1 per year by 3rd class mail, $3 for 1st class, $5 airmail, and $7.20 special delivery. Published twice a month. Contains classified ads entirely. This is your best bet for an inexpensive way to sell or swap some gear in a hurry. Within two weeks people are answering your ad.

FLORIDA RTTY BULLETIN. Fred W. DeMotte W4RWM, P.O. Box 6047, Daytona Beach, Florida. $3 per year including membership in Florida RTTY Society. Mostly operating news with a bit of technical info now and then. All TT men should be getting this.

SOUTHERN CALIFORNIA RTTY BULLETIN. Merrill L. Swan W6AEE, 372 West Warren Way, Arcadia, California. $2.75 per year, not including membership in Society. Operating news and some technical articles. This is the oldest TT bulletin going. All TT men should also get this one. Monthly.

73 HAM CLUB BULLETIN. Marvin Lipton VE3DQX, 311 Rosemary Road, Toronto 10, Ontario, Canada. Sent free to all editors of ham club bulletins monthly to keep them abreast of what is going on with all the other ham clubs. This is an excellent source of news for putting together your club bulletins. To subscribe to this news bulletin just send a copy of your own club bulletin to Marvin.

WESTERN RADIO AMATEUR. Don Williamson W6JRE, 10517 Haverly Street, El Monte, California. Monthly. Subs are $2 per year, $3.50 for two years, $5 for three years. Operating news of west coast activity, columns on DX, SSB, YL, and some articles. 48 pages.

SIDEBANDER. Official organ of the Single Sideband Amateur Radio Association, 12 Elm Street, Lynbroo L. I., N. Y. Subs include membership to SSBARA: $ per year. Monthly. Primarily operating news and chit chat for the SSB DX gang. Columns by W8YIN K5MWU, K6EXT and occasional technical info.

THE MONITOR. Mar-Jax Publishers, 507 West Davi Street, Dallas 8, Texas. $1 a year, 3 years for $2.50 Monthly. Largely operating news. Columns: YL, Clul Meetings, Arkansas News, Mississippi News, Florid News, DX, Missouri News, MARS, California New Louisiana News, VHF News, Oklahoma News, Ri Grande Valley News, Novice News.

VHF AMATEUR. 67 Russell Avenue, Rahway, Ne Jersey. $2 year, $3.50 two years, $5 three years Monthly. Operating news for VHF men. Some tec nical info.

DX-QSL News Letter. Clif Evans, K6BX, Box 38 Bonita, California. Published quarterly. 40¢ each; A nual subscription $1.25 (four copies) by first cla mail ($1.50 for DX stations). Lists all QSL Bureau managers for rare DX stations, etc.

DIRECTORY OF CERTIFICATES AND AWARDS. Cl Evans, K6BX, Box 385, Bonita, Cal. Complete Dire tory plus one year of revisions (quarterly) $3.50. Ad 75¢ for 1st class mail; $1.25 for airmail; DX station 1st class mail add $1.00. Needless to say, this is th most complete collection of data on the hundreds c certificates and awards available.

MOBILE NEWS. Published monthly by the Amate Radio Mobile Society, 79 Murchison Rd., Leyton, E 10, England. Joining fee and 1 year sub. is $2.50

DX BULLETIN. Don Chesser W4KVX, RFD 1, Burlin ton, Kentucky. DX news in depth. Published weekl 3rd Class mail $5 year; 1st class $6; Airmail $7.50 DX rates on request.

(FREQUENCY METER from page 40)

age is far above the 200-millivolt level. If thi seems a disadvantage, it can be overcome b putting an emitter-follower amplifier ahead o the limiter circuit as shown in Fig. 5. Thi amplifier was omitted in the prototype be-

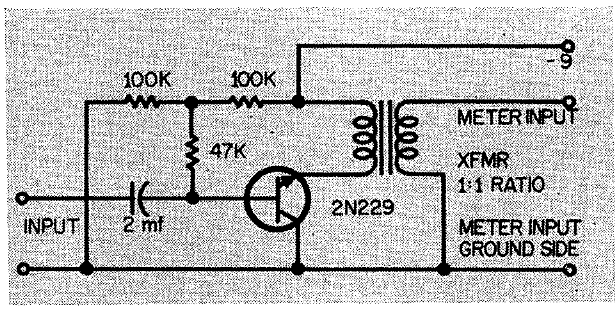


Fig. 5—This tiny preamplifier may be added to the input of the frequency meter to increase the meter's ability to indicate frequency of voltage-only sources. The emitter-follower circuit has an input impedance of nearly half a megohm, reducing loading effects, and provides more than 10 db current gain, which will more than fully drive the frequency meter from any ordinary signal. Any small transistor-type interstage transformer may be used; its prime purpose is to keep all dc out of the frequency-meter input.

cause it was felt unnecessary.

That's all there is to it—except justificatio of the "Five-Dollar Frequency Meter" nam Cost breakdown for a single-range unit is:

2	2N107 Transistors	$1.80
1	0-10 ma. meter	2.06
4	½-watt resistors	.60
1	200-volt capacitor	.15
	Total	$4.61

This is based on use of a moving-vane mete and no range-switching features. Use of d'Arsonoval movement and a range switch wi boost the cost a bit, but it will still be ver reasonable for such a versatile unit. Have fu with the freq meter, and happy homebrewin

References

Basic Theory

Electronics Magazine, January, 1945.

Electronic Measurements, p. 223, F. E. Terman and J. M Pettit, McGraw-Hill Book Co., Inc., New York, 195

Basic Electronic Test Instruments, pp. 200-203, Rufus I Turner, Rinehart & Co., New York.

Electronic and Radio Engineering, Fourth Edition, p 606 and 662, F. E. Terman, McGraw-Hill Book C Inc., New York, 1955.

Transistor Manual, Fourth Edition, pp. 89-91, The Ge eral Electric Company, 1959.

Construction Articles

Radio and Television News, February, 1951, p. 54, Ruf P. Turner (AC operated instrument).

Radio-Electronics, February, 1952, p. 25, H. O. Maxw (AC operated instrument).

The C-D Capacitor, February, 1956 (Battery operate with tubes).

CQ Magazine, January, 1958, p. 72 (Transistorized i strument).

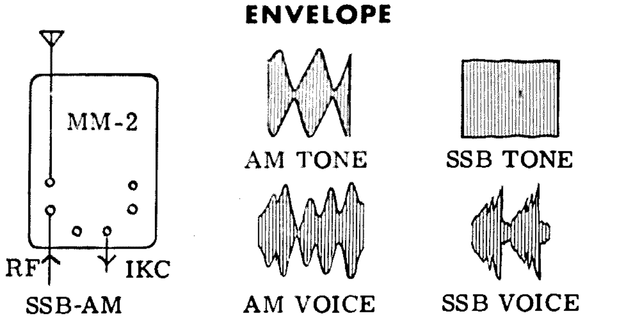
THE MULTIPHASE MODEL MM-2
RF ANALYZER

- Monitors the RECEIVED and TRANSMITTED signals. Shows flat-topping, overmodulation, parasitics, keyed wave shape etc. Silent electronic switching keyed by transmitted RF.
- No tuning required. Broadband response flat 1 MC to 55 MC at power levels of 5 watts to 5 KW.
- New variable sweep control for transmit and receive.
- RF attenuator controls height of pattern. Calibrated in 3 DB steps.
- Function selector for ENVELOPE, TRAPEZOID and BOW-TIE patterns on transmit. For SSB, DSB, AM and CW.
- Built-in 1 KC audio oscillator, less than 0.5% distortion. With 3" scope, is ideal for complete alignment of SSB exciters.
- For use in series with 52-72 ohm coax lines. A short pickup antenna may be used with other systems.
- Plug-in adaptors available to match 50 KC, 60 KC, 80 KC or 455 KC receiver IF systems. Only one simple connection to receiver.

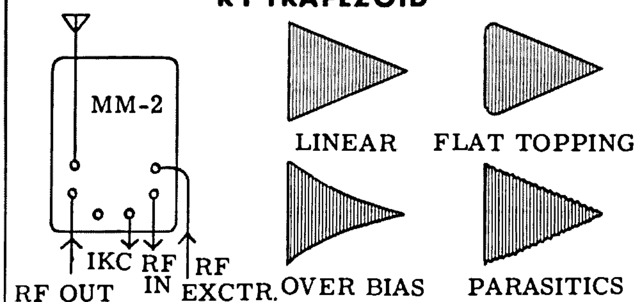
THERE IS NO SUBSTITUTE FOR A SCOPE IF YOU WANT THE CLEANEST, MOST PERFECTLY MODULATED SIGNAL YOUR TRANSMITTER CAN PROVIDE. THE MM-2 IS BY FAR THE MOST DEPENDABLE and EASIEST TO USE, SINCE IT WAS DESIGNED STRICTLY FOR THIS PURPOSE.

MM-2 Kit ... (less IF adaptor). $119.50
Wired ... (less IF adaptor). $149.50
Plug-in IF adaptors (wired only) ......
RM-50 (50 KC), RM-80 (60-80 KC),
RM-455 (450-500 KC)... ea. .. $12.50

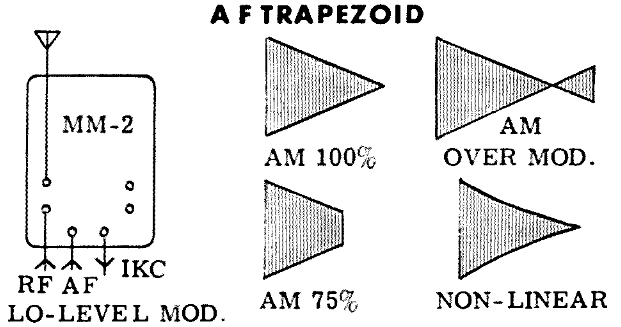
ENVELOPE



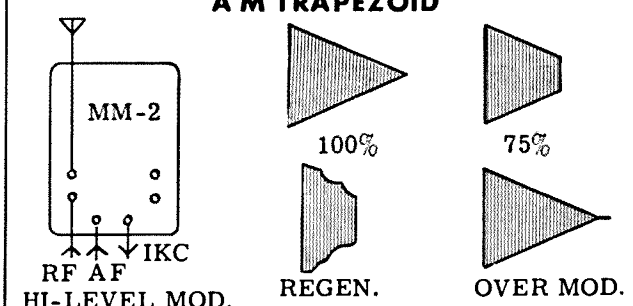
R F TRAPEZOID



A F TRAPEZOID



A M TRAPEZOID



OTHER FINE C.E. PRODUCTS

Model 100V .... New 100 Watt Broad-Band Exciter-Transmitter .. $795.00
Model 600L .... Broad-Band Linear Amplifier $495.00
* Model 20A .... Bandswitching SSB Exciter $299.50
* Model 10B .... Multiband SSB Exciter $193.50
* Model GC-1 ... Gated-Compression Amplifier .... $ 66.50
* Model B ...... Sideband Slicer with Q Multiplier $104.50

* Also available in kit form
AND MANY OTHERS ... WRITE FOR LITERATURE

THE SSB PIONEER

MULTIPHASE EQUIPMENT

Central Electronics, Inc.
1247 W. Belmont Ave. Chicago 13, Illinois
A subsidiary of Zenith Radio Corp.

(MODULATION from page 25)

by means of varying coupling to the final—so that its trace just touches the 0 lines, the minimum voltage trace will be directly proportional to modulation percentage which can then be read directly from the overlay.

When you use this gadget, you'll find that your "modulation level" on CW will read 33.3 percent instead of 0. However, the pattern will not reach to the 0 line at any time on CW unless you readjust the coupling to the final. The additional voltage necessary to raise the pattern from 33 3 percent to 0 percent at the high side on voice comes from the modulator —it's the "talk power" of your sidebands.

You may also be sure, the first time you use this, that something's wrong with the overlay. There's a great possibility that you'll read less than 70 percent modulation.

Dont' cuss the gadget. The facts are sad but true; a majority of ham transmitters presently on the air produce only about 70 percent modulation level in practice. In many cases, attempting to exceed this level by means of advancing the audio-gain control results in distortion and splatter.

But that's no fault of the measuring overlay. The place to correct that problem is inside the transmitter. The cures for modulation troubles would fill an article in themselves, and every transmitter poses a different situation.

However, once you know that you have a problem, you're halfway toward solving it. Have fun with the overlay, and here's hoping you increase your talk power with it. 73

(TOROID COILS from page 37)

with the insulators is recommended to avoid damage to the coil, core and insulators.

The remaining problem associated with the use of ferrite toroid cores is the general lack of availability through normal distributor outlets. While the references cited give sources for certain specified cores, variety is limited and prices, for these special items, are high. It is the writers personal conviction that the alert manufacturer who makes available, in distributor channels, a line of a dozen or so reasonably priced, general purpose toroid cores will make a killing. Cores made of low, medium and high frequency ceramic and supplied in three or four physical sizes should meet most experimental requirements. If this article assists in making these core materials more readily available, it will more than have served its purpose.

The radio amateur has been responsible for many state of the art advances in the dual fields of communications-electronics and this new area offers fertile ground for experimentation. Try working with toroid rf inductors. Increased knowledge and skill will be yours, since the surface is barely scratched in amateur and commercial application of this new component family.

(WABBIT EARS from page 41)

some rf into the feed line as far as pattern is concerned. First we find that the usual figure eight pattern that we get from the standard center fed dipole has been modified considerably. The eight figure has lost weight and grown in height, which means we are bi-directional and showing gain on the two sides at right angles to the plane of the antenna. We are also down in radiated energy off the ends of the elements. We are making good progress toward our objective.

We now come to the last, but far from the least, point of interest. With the elements at an angle of 45 degrees from the vertical, we find that the antenna will respond to both vertically and horizontally polarized wave fronts. This is a very nice thing to have at any frequency and at higher frequencies much desired. There are great gobs of "Hairy Old Theories" regarding how waves turn and roll after leaving the antenna system, but anyone who has used a ground plane antenna will confirm the fact that there are times when they can take all comers, and other times when the Horizontal boys take over.

The simplest form of this type of system has been used for about one year at the writer's location. The antenna is cut for 14.100 megacycles and fed with RG8/U cable. The elements are made of sections from tank whip antennas, which are 3 foot lengths and screw together. Each section is also tapered progressively. The base of the 90 degree angle where the feed line attaches, is 25' above ground. The unit is rotated by a TV type rotator. The effective height of the antenna, using the center of one element as reference, is approximately 32' above ground.

Using 800 watts input the results have been most gratifying. The DX signals have been increased in intensity to a point where armchair copy is standard practice. The reports from all contacts show a marked improvement in transmitted signal over the ground plane and two-element beams previously used.

The "Dual Polarity Personality" gives substantial evidence of longer staying power during conditions of change in fading periods. Also the "fade" on this system is much less than on other types of antennas which have fixed polarity. This was tested by switching rapidly from horizontal to vertical polarization as compared to the "V" configuration.

The possibilities of applying this principle to multi-element beams is obvious and plans in the near future are to construct a three-element parasitic beam with the angled elements, to gather full data. Again the test will be conducted on scaled down models at UHF frequencies before moving to full size 14 megacycle elements.

In closing gentlemen, try one, and you too can have the largest pair of "Wabbit Ears" in your area. 73

Air Force MARS Eastern Technical Net

Sundays from 2-4 pm: 3295, 7540, 15,715 kc.

Nov. 6—Trip report: Impressions of the Technological Status of Electronics Production in the U.S.S.R.

Nov. 13—Trip report: Impressions of an American Engineer-Visitor to the U.S.S.R.

Nov. 20—Electromagnetic Compatibility.

Nov. 27—Applications of Ultrasonics.

Dec. 4—Principles of Guidance and Navigation, and Inertial Devices.

Decoding the Address Label

In addition to your name and address on your label you will find the usual hieroglyphics. Our system is deucedly simple since we didn't have anyone with enough experience to work out a complicated one. The first two numbers tell us when you first subscribed . . . 80: eighth month of 1960. The last two tell us which is the last issue to send . . . 92: September 1962. To get away from the nuisance of using extra numbers we use an "N" for November, and guess what for December.

(10 METER CONVERTER from page 11)
e transistors provisions can be made for ounting small transistor sockets. ELCO 3301 ckets are ideal transistor sockets for circuit ›ards. The sockets make it easy for experi- nting with various transistors.

The coils should be wound and ready for ounting next. Coil data is found under Cir- iit Drawing, Fig. 1. L1, L2 and L3 are wound ı 3/8" diameter ceramic coil forms which are on slug tuned. L4 is a vari-loopstick with e secondary scramble wound over the pri- ary. The coil taps are made by twisting a " of coil wire at the appropriate place for e tap. The twist is then stripped by holding e twist in a match flame and finishing with ıe steel wool or emery paper. After stripping e twist can then be solder tinned.

The coils and transistor sockets can now be ›unted on the circuit board. Following Fig. 3 e resistors and capacitors may be mounted d soldered in their proper place. Care should used when soldering on the circuit board. ıly hold the heated iron on long enough to ıke a good soldering connection and use only good rosin core solder. Capacitors C7, C8 and › are soldered directly across coils L1, L2 d L3. After all components have been ›unted and soldered check the circuit board rough with Circuit Drawing Fig. 1 to elimi- te any possible mistakes. The X-sistor Con- rter is now completed and ready for final justments. The converter may be covered th any type of a box. The author used a x 4" x 2" Bud aluminum chassis with J1 d J2 fastened closest to the input and out- t.

Adjustment and Operation

Before operating the converter use a grid-dip ›ter to tune the local oscillator to approxi- ıtely 28 mc. This check is made with the ıverter switch off and by adjusting L3 for dip. Adjust L1 and L2 for approximately mc. Additional accuracy may be obtained checking the oscillator if another receiver ıed to 28 mc is used. If this method is used, n the converter switch on and adjust L3 til a beat note is heard on the receiver.

[t is necessary to use a length of shielded ›le between the converter and the auto re- ver. After making this connection and turn- the receiver and converter on you should .rt to hear signals. Final peaking is best ıe by tuning in a signal and adjusting L1 d L2 for greatest speaker output. When ng a 28 mc crystal, signals at 28.5 mc will pear at 500 kc and 29.5 mc signals appear at)0 kc on the broadcast band dial. After the al adjustments are made the converter may mounted at any convenient place on the to dash and you will enjoy many hours of ening on the 10 meter amateur band. 73

Instructions for using Radio Bookshop:

1) Read list of books and mark those you **must** have.
2) Check off the same numbers on the order blank.
3) Total up the bill and enclose a check, money order or cash.
4) Put the whole works in an envelope, address and mail.
5) Don't forget the stamp.
6) Or your return address.

1—ELECTRONICS & RADIO ENGINEERING—Terman. One of the most complete text books ever printed. 1078 pages. Theory, but easy on the math. **$14.50**

2—ELECTRICAL ENGINEERING HANDBOOK—McIlwain. Formulas, tables, circuits. A real handbook. 1618 pages. **$10.00**

5—ANTENNAS—Kraus (W8JK). The most complete book on antennas in print, but largely design and theory, complete with math. **$11.50**

10—1, LIBERTINE—Shepherd (K2ORS). Racy 35¢ book, a best-seller. Specially priced for you at . . . **50¢**

20—RTTY HANDBOOK—Kretzman (W2JTP). A-Z of ham Teletype. Very popular book, low supply. **$3.00**

21—VHF HANDBOOK—Johnson (W6QKI). Types of VHF propagation, VHF circuitry, component limitations, antenna design and construction, test equipment. Very thorough book and one that should be in every VHF shack. **$2.95**

22—BEAM ANTENNA HANDBOOK—Orr (W6SAI). Basics, theory and construction of beams, transmission lines, matching devices, and test equipment. Almost all ham stations need a beam of some sort . . . here is the only source of basic info to help you decide what beam to build or buy, how to install it, how to tune it. **$2.70**

23 — NOVICE & TECHNICIAN HANDBOOK — Stoner (W6TNS). Sugar coated theory: receivers, transmitters, power supplies, antennas; simple construction of a complete station, converting surplus equipment. How to get a ham license, build a station and get on the air. **$2.85**

24—BETTER SHORT WAVE RECEPTION—Orr (W6SAI). How to buy a receiver, how to tune it, align it; building accessories; better antennas; QSL's, maps, aurora zones, CW reception, SSB reception, etc. Handbook for short wave listeners and radio amateurs. **$2.85**

28—TELEVISION INTERFERENCE—Rand (W1DBM). This is the authoritative book on the subject of getting TVI out of your rigs and the neighbors sets. **$1.75**

32—RCA RADIOTRON DESIGNERS HANDBOOK—1500 pages of design notes on every possible type of circuit. Fabulous. Every design engineer needs this one. **$7.50**

40—RADIO HANDBOOK, 15th EDITION—Orr (W6SAI). This is far and away the best amateur radio handbook ever printed. Over 800 pages. **$7.50**

45—CURTA COMPUTER. The world's smallest computer. Send for detailed information. Makes the slide rule look sick. Like a big Monroe computer only hand size. **$125.00**

47 — PRACTICAL ELECTRONICS — Hertzberg (W2DJJ). Almost solid with pictures. Touches lightly on many aspects of electronics: ham radio, TV, transistor radios, hi-fi, microwaves, trouble-shooting, Novice station, antennas, test equipment, etc. **$2.50**

48—BASIC ELECTRONICS—Covers subject completely. Written for use with RCA Institute training course. **$9.25**

49—ELECTRONIC COMMUNICATION—Shrader. Huge book aimed at giving all information necessary for FCC commercial and amateur licenses. **$13.00**

50—MICROMINIATURIZATION—This is the standard text on the subject. Don't see how a company library can be without this one. Everything is going to have to be built smaller, you know. **$11.00**

52—HOW TO READ SCHEMATIC DIAGRAMS—Marks. Components & diagrams; electrical, electronic, ac, dc, audio, rf, TV. Starts with individual circuits and carries through complete equipments. **$3.50**

53—BASIC ELECTRONIC TEST PROCEDURES—Turner. This book covers just about every possible type of electronic test equipment and explains in detail how to use it for every purpose. Testing: audio equipment, receivers, transmitters, transistors, photocels, distortion, tubes, power . . . etc. **$8.00**

54—HAM RADIO HANDBOOK—Hertzberg (W2DJJ). This is a lavishly illustrated book to interest people in the hobby of ham radio. Tells how to get your ticket, select a receiver and transmitter, learn the code. Pictures and info on just about every commercial piece of ham equipment. Better than a catalog. **$2.50**

55—TRANSISTOR CIRCUIT HANDBOOK—Simple, easy to understand explanation of transistor circuits. Dozens of interesting applications. **$4.95**

56 — RADIO TELEPHONE LICENSE MANUAL — Smith (W6BCX). Brand new question and answer study guide for FCC commercial licenses. **$5.00**

57—QUAD ANTENNAS—Orr (W6SAI). Theory, design, construction and operation of cubical quads. Build-it yourself info. Feed systems, tuning. **$2.85**

58—ANTENNAS FOR CITIZENS RADIO—Orr (W6SAI). General coverage, mobile and directional antennas for 27 mc. band. Build & tune 'em. **$1.00**

69—S-9 SIGNALS—Orr (W6SAI). A manual of practical, detailed data covering design and construction of highly efficient, inexpensive antennas for the amateur bands that you can build yourself. **$1.00**

70—CITIZENS RADIO CALL BOOK—Lists all calls issued until January 1960, plus lots of CB info. **$3.95**

71—CITIZENS RADIO CALL BOOK SUPPLEMENT—Calls from January 1960 until July 1960. **$3.95**

72—ABC's OF HAM RADIO—Pyle (W7OE). Designed for the Novice ham. Includes all of the information needed to qualify for the Novice License. 112 pages. **$1.50**

73—101 WAYS TO USE YOUR HAM TEST EQUIPMENT—Middleton. Grid-dip meters, antenna impedance meters, oscilloscopes, bridges, simple noise generators, and reflected power meters are covered. Tells how to chase trouble out of ham gear. 168 pages. **$2.50**

74—HANDBOOK OF ELECTRONIC TABLES & FORMULAS—Formulas & laws, constants, standards, symbols and codes. Math tables, misc. data. **$2.95**

75—BUILD-A-WARD QSL ALBUM—Mount your prize QSL's in this album. Room for 100 cards in each album plus labels for just about all possible operating awards. A fine way to show off your cards. **$1.95**

76—MODERN OSCILLOSCOPES & THEIR USES—Ruiter. Second edition. Shows what a 'scope is, what it does and how to use it for radio, TV, transmitters, etc. 346 pages. **$6.50**

77—BASIC ELECTRICAL MEASUREMENTS—Stout. Second edition. Covers aids to computation, measurement of resistance, galvanometers, shunts, standard cells, potentiometers, alternating current bridges, mutual inductance measurements, bridge accessories, instrument transformers, magnetic measurements . . . and lots more. **$11.65**

Advertisers Index

Next Month

We've got a lot more construction articles lined up for December. Probably the one that will have the most fellows rushing to the workshop is the **RF Sniffer,** which you can put together very easily and use a lot. The VHF boys will get the build-its when they see the job ZL1AAX did on a **Low Noise Two Meter Converter.** This is the most modern and up to date design yet. K5JKX presents one of the first articles we've seen on **How To Transistorize** your tube circuits. And while we're transistorizing, we have a brand new circuit . . . the first time anywhere . . . a **220 mc Transistorized Crystal Controlled Converter.** Then we have the world's **Simplest Phone Patch,** an interesting **Station Control Unit,** a **Multivibrator VOX** circuit, a **Dynamic Demonstrator** for SSB, a feature article on squelch circuits, and a raft of other articles.

Send Cash

or check made out to: 73 Magazine

You've seen two issues by now (unless you read from the back of the magazine) and you should see that we really are going to bring you top notch articles every month, and lots of 'em. We can do even better if you'll give us a helping hand. When you're on the air tell the fellows about **73** and some of the articles in here. Tell your club members. Get a writeup on **73** into your club bulletin. Bludgeon your close friends into subscribing. If they like to build **then they've got to subscribe.** Let's get some of the fun into your hobby.

73 Subscription: $3.00 one year; $5 two years; $7 three years. DX: Add $1.00 per year.

Send to: 73 Magazine, 1379 East 15th St., Brooklyn 30, N. Y.

Name .... Call ....

Address ....

City .... Zone ... State ....

.... years. Start with issue ....

Name .... Call ....

Address ....

City .... Zone ... State ....

.... years. Start with issue ....

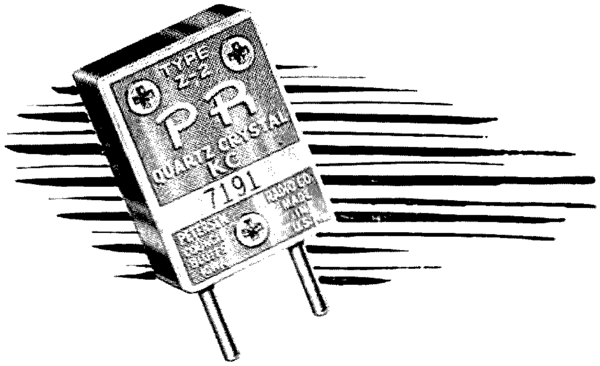
Name .... Call ....

Address ....

City .... Zone ... State ....

.... years. Start with issue ....

ONLY THE BEST IS GOOD ENOUGH!



In many respects, Crystals are like "diamonds." You can buy them from six-bits up. It may be difficult to tell quality from a distance, but measured under close-up of performance, accuracy and stability . . . quality stands out. After all, your frequency control is the heart of your transmitter. When you trust your frequency to PR you know where you are . . . today, tomorrow and years from now. This is worth a great deal. In the long run the money you put in a crystal is not important . . . because even quality PRs cost little. When you buy a PR from your jobber you can get the exact frequency you want (integral kilocycle) within amateur bands, at no extra cost. You can be where you want to be . . . not within 5, 10 or 15 KC., but JUST WHERE YOU WANT TO BE! That means a lot.

40 and 80 Meters, PR Type Z-2....$2.95

Citizens Band, Type Z-9R............$2.95

PR Crystals

Since 1934

USE PR AND KNOW WHERE YOU ARE

PETERSEN RADIO COMPANY, INC.
2800 W. BROADWAY • COUNCIL BLUFFS, IOWA

EXPORT SALES: Royal National Corporation, 250 W. 57th Street, New York 19, N. Y., U. S. A.

73

December 1960

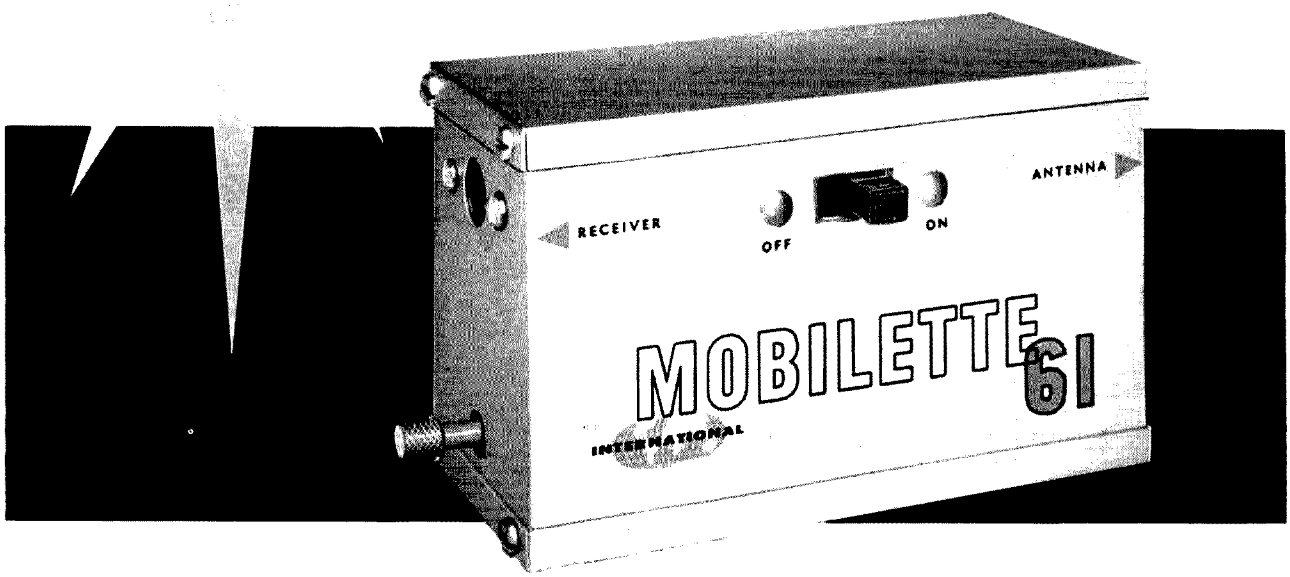
37¢

Amateur Radio

AMATEURS

CITIZEN LICENCEES

MOBILETTE 61



MOBILETTE 61, International's *new improved* all transistor, crystal controlled converter provides a "quick and easy" way to convert your car radio for short wave reception. MOBILETTE 61, units cover a specific band of frequencies providing a broad tuning range. Mobilette units are miniature size and quickly interchangeable.

Check these all New features . . . New and improved circuit for increased gain . . . New internal jumper for positive and negative grounds . . . New RF amplifier, mixer/oscillator . . . New separate input for broadcast and short wave antennas . . . Mounting bracket for under dash installation.

MOBILETTE 61, is available in a wide choice of frequencies covering the Amateur bands 75 through 6 meters, Citizens band, Civil Air Patrol

73 Magazine

1379 East 15th Street
Brooklyn 30, N. Y.

December, 1960
Vol. 1, No. 3

Table of Contents

Staff:

editor-publisher .... Wayne Green W2NSD
publications manager .... David Fish
associate editor .... Jim Kyle K5JKX
associate editor .... Don Smith W3UZN
associate editor .... Jim Morrissett WA6EXU
contributing editor .... John Campbell W2ZGU
subscriptions .... Virginia K2MNW

The Cover: Virginia mulls over the shopping list we've assembled on page 6. All items are under $20 and are needed in every ham shack. Photograph by Mort Weldon.

73 (Title registered U. S. Post Office) is published monthly by Amateur Radio Publishing, Inc. Executive and editorial offices at 1379 East 15th Street, Brooklyn 30, New York. Telephone: INgersoll 9-6957.
Application for entry as second-class matter is pending at Norwalk, Conn.
Subscription rates: U. S. A. and possessions, APO, FPO, Canada and Mexico; one year $3.00; two years $5.00; three years $7.00. Foreign: one year $4.00; two years $7.00.

Postmaster: send form 3579 to 73 Magazine, 1379 East 15th Street, Brooklyn 30, New York.

. . . de W2NSD

PLEASE forgive me for being still somewhat mesmerized with the sudden existence of 73 and with the myriad of problems that have attended the birth. Maybe in a month or so I will come out of my cocoon and have something significant to say. Maybe, but probably not.

Either a lot of people skipped over the list of the "policies" of 73 which were printed in the first two issues, or else they have to have things spelled out in words of fewer syllables. For instance I'm asked frequently when we're going to have a VHF column. Putting on an obviously condescending look and speaking with biting sarcasm I refer them to Policy #5 and explain that in the second issue we had, for the VHF men, the "Four Band Crystal Converter," the "FM VFO Exciter," an article on noise clipping, "Hard Facts about Echo," "Improving the Performance of the Communicator III," the "VHF Tri-Mode Receiver" and "Finding True North." If we had had a VHF column we would also have had to have a DX column, a Sideband column, a YL column, a Novice column, a Technician column, , transistor column, ad nauseum, and we wouldn't have had room for anything else, much less seven feature articles of interest to VHF'ers.

Further, if we use space for operating news of interest to only a small group we are robbing everyone else. Consider too that it takes about two months at least for such news to get into a monthly magazine like this and by this time everything is just a matter of record. If we don't run a VHF column we then encourage those fellows who are interested in reading operating news to subscribe to the VHF Amateur for $3 a year and get the VHF news in extreme detail and get it considerably faster than they ever could through us. We'll still be specializing in the construction articles and things like that.

This same thing goes for the DX enthusiast. Why run a DX column in a monthly magazine when the news you get is much too old to help anyone. If you subscribe to the DX Bulletin at $5 a year you get a weekly detailed bulletin which lists just about every DX station on the air and tells you where and when to look for 'em and where to send the QSL. You can read about DXpeditions in time to work 'em instead of finding out about which ones you missed two months later.

Likewise the classified ads. As long as Ham Swap is around doing a better service cheaper and faster than we could do we are doing them harm and our readers a dis-service to compete with them. At $1 a year you can afford to have it come and not even read it just on the chance that you will eventually want something. Then, when you do, you can pull out the paper and find it quickly. It comes out every two weeks which is a real good deal both for the seller and buyer. I've sent for things in classified columns only to find that they were sold over a month ago, before the ad ever appeared.

More Worth

The survey results published last month were so interesting that it seemed only fair to run the survey again this month. I must admit that I was somewhat shaken to find myself trying to compare poor little 73 with two 184 page contemporaries, one selling for 50c and one for $1.00! But, Never Say Die and let the chips fall where they may, etc. Here are the results of the fearless survey of actual pages devoted to technical or construction articles in November 1960.

73 Magazine	**38 pages**
Brand X	**33 pages**
Brand Y	**35 pages**

Conventions

Probably the biggest event locally in the hammisphere was the Hudson Amateur Radio Council Convention which was held at the Statler-Hilton Hotel. Multitudes of hams poured over some 34 exhibits by manufacturers and distributors. Two unusual events marked this Convention: the opening tape was cut by moonbounce signal (a photo of the apparatus involved appeared on page 6 of our November issue . . . unfortunately we left off that all important credit line to Leonard Victor W2DHN, who snapped the Picture . . . sorry LV, but you attached a subscription to your accompanying letter and our efficient subscription department confiscated it) and Jean Shepherd K2ORS was the Master of Ceremonies. Too bad if you missed it this year. Jean was hilarious.

Another high spot was the illustrated talk on the western end of the Great Moonbounce Record by Bill Orr W6SAI. You also missed the mighty persuasive sales pitch I made to every one who ventured near the 73 booth.

Feedback

There has been a little note in each issue of 73 asking you to drop me a card listing the articles that you found most interesting. The votes are still coming in for issue #1, but we have to call a halt somewhere. The results of this first poll are very interesting. Jim Kyle K5JKX/6 gets a check for 50% extra with the most votes for his Audio Booster article. Almost tied with this one was the Bantam Converters article. Close behind and tied for third place were our technical article on Modulation and the Capacity Meter.

Every article in the issue received at least one vote for first place and none lagged seriously in the voting.

We're getting even more votes on the second issue, but I suspect I'll have to run a short list somewhere for you to cut out and mail in before we get really solid results. A postage paid card would be nice, but not at these subscription rates.

Please take the time to congratulate an author that has pleased you by dropping me a card with a vote for his article. I would prefer that you list the five most interesting articles in the order of your interest, but I'm not picky.

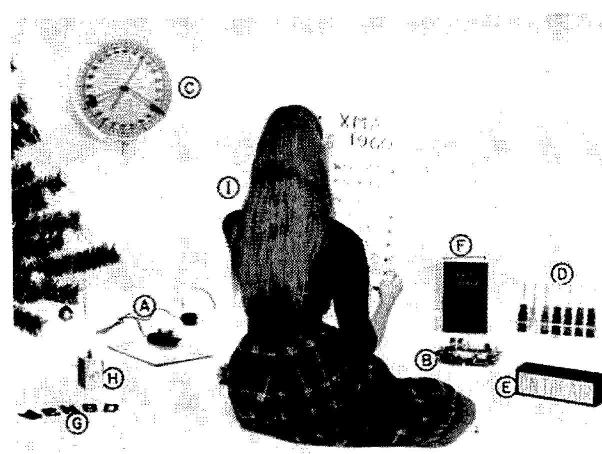
Advertisers

Several of the larger advertisers are still obviously missing from our pages. When you have occasion to write them on other business you might mention this oversight to them. Apparently some of you have already been plucking their coatsleeves for one of the largest mentioned that they had received a couple such letters. Unfortunately they pointed out that the company had no intention of advertising in 73 in the foreseeable future. We need all the advertisers we can get . . . but this is up to *you*. I would like to print a lot more pages of articles each month, but I can't run more than two pages of articles for every page of advertising without economic disaster overtaking me. If you'd just written to a few more of the November advertisers we'd have been able to run 80 pages in this issue!

Shopping List

If your family is anything like mine they start hounding you along about this time for a list of things you'd like for Christmas. It is wise to prepare one, for Christmas can turn into a day of horror if you find yourself opening box after box of sox and neckties.

With one eye on the pocketbook (limit $20) and the other scanning magazine ads and catalog promises, a list of goodies has been prepared which should be welcomed by any ham. I've tried to list things which we all would like to have and which don't call for any knowledge of the part of the buyer as to what bands you operate or what equipment you may be using. A couple of these ideas are ostensibly for the junior op, but I suspect that he may have trouble getting you away from 'em long enough to break 'em.



A. The Key-municator, manufactured by Dow Key, costs $9.95 and is available from almost any good parts distributor. This consists of a hand key with a transistorized audio oscillator built right into the base. A headphone comes with it for copying. The key is mounted on a board which has the Morse code on it. This is one of the best deals I've seen yet to get the jr. op interested in CW. When you can get it away from him you can feed the tone into your vhf rig for ICW sending. Any number of these gadgets can be hooked

together for code classes or sending from one house to another.

B. Another doohinky that the kids will get a big kick out of is this ten circuit transistor kit. This can be assembled in a few minutes and then, by means of changing the plug-in wires in the printed circuit board, you can make the circuit into a two stage AM radio, a light operated relay, a wireless broadcaster, a code practice oscillator, an electronic switch, a two stage audio amplifier, a body-capacity burglar alarm, a voice operated relay, or an electronic flasher. A card fits into the center of the board showing where to make the connections for each circuit. Costs $15.75 from Allied Radio. Better order quickly and give the U.S. Mails time to deliver before Cringle is due.

C. This 15" wall clock by Scientific Industries costs $19.80 (just under our $20 wire) and has a 24 hour illuminated dial. This is fabulous for any shack. I seriously doubt if there is a ham alive who wouldn't be delighted to have one of these given to him. This is the kind of gadget that you seldom buy for yourself, but really appreciate getting from someone else.

D. Nut Drivers by Xcelite. The set of seven fit all common radio nuts from ¼" to ½" and have long hollow handles so the nuts can be screwed on even when there are bolts sticking out. No ham shack is complete without a set of these. They're available at most parts distributors for $7.47.

E. "ON THE AIR" sign which lights up when the rig is turned on. This unit is just like the ones used by commercial radio stations, only it costs but a fraction of the price: $6.95 from Stellar Electronics. Besides being flashy (pun intended), this sign also puts visiting loudmouths on notice to button up. Comes in grey or black case.

F. The Radio Handbook, latest edition, by Editors and Engineers. This is the best ham handbook ever printed and no hamshack should be without it. Cost is only $7.50 from Radio Bookshop or your local parts distributor. This edition was written by Bill Orr W6SAI, so you know it's got to be good. There are dozens of interesting construction projects in it plus just about everything else you could ask for in a ham handbook.

G. Felt call letters that can be ironed on your jacket. Great for field day, picnics, hamfests, club meetings, or just plain bragging. Washable, I understand. They cost 20c per letter or number from K9TVA Enterprises in the 3" size and 10c each for the 1" size.

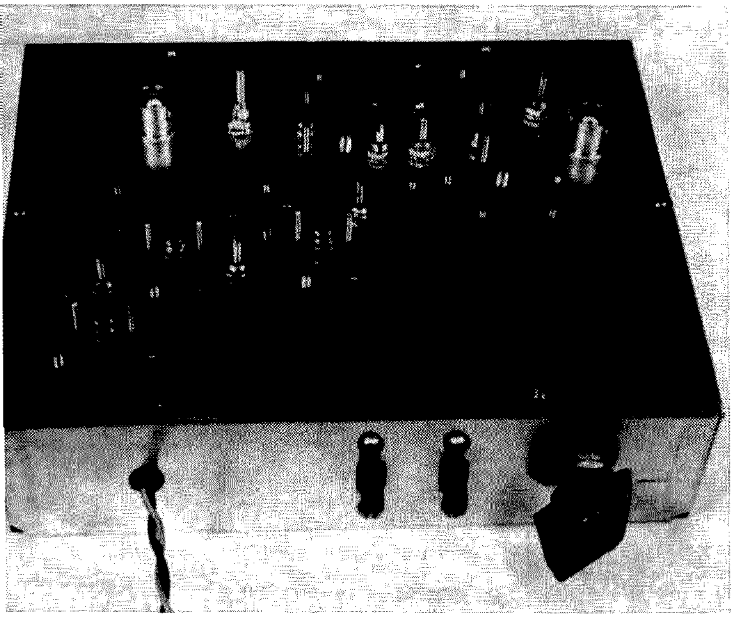
H. 100 kc Crystal Callibrator kit by Heath. This $14.95 kit comes complete with battery and transistor. It provides marker frequencies every 100 kc from 100 kc to 54 mc. Every ham shack must have some sort of frequency standard and this one certainly is the least expensive you're going to find for a while. This is model HD-20 and is available from Heath or from any Heath distributor.

I. Not available.

Manufacturers Please Note

When an amateur gets the bug to buy something the next step normally is for him to drag out the back issues of his ham magazines and look through them to try to find some information. Wouldn't it be clever if all manufacturers ran at least one ad on each of their current products during each three or four

(Continued on page 53)



A Transistorized Crystal Controlled Converter

. . . for the 220 mc (1-¼ meter) Amateur Band

J. Specialny W3HIX
Philco Corporation/Lansdale Division

This report describes a 1¼ meter converter for the 220-225 mc amateur band. It employs five Philco MADT VHF transistors and operates at a supply voltage of 12 volts. A communications receiver capable of tuning the 10 to 15 mc frequency range can be used as the *if* system.

THE unit employs five transistors, all operating in common emitter configuration. Transistor TR1, operating as a neutralized rf amplifier, is coupled to the mixer through a double tuned circuit. This method of interstage coupling is preferred because of its ability to reject signals outside the rf bandpass and to minimize feed through at the *if* frequency. The antenna is coupled to the amplifier through a tap on the input coil L1. Shunt capacitor C1 tunes the input circuit to the proper frequency. A series matching capacitor C2 applies the incoming signal to the low impedance base which typically is about 60 ohms. Neutralization is provided for by a capacitor network consisting of C3 and C6. Neutralization provides an increase in rf power gain of approximately 3 db as well as good circuit stability, although the amplifier would be quite stable if neutralization was not used.

The rf amplifier output circuit is tuned by inductor L2 and capacitors C4 and C5. A manual rf gain control is incorporated to reduce the gain on strong signals. The method used here is termed "forward gain control" and is noted for its excellent overload characteristics. The term "forward" is derived from the fact that the collector current is increased to reduce the stage gain rather than decreasing the collector current as is done in the reverse method. A resistor R5 is inserted in series with output circuit and the negative terminal of the power supply. As the current increases by adjustment of gain control potentiometer R3 the voltage available between the collector and emitter of the rf stage decreases causing the gain to drop. This drop in power gain is nearly linear as the collector to emitter voltage is varied from eight volts to one half a volt. The MADT is the only VHF transistor suited for this type of gain control. Resistor R4 provides emitter stabilization and resistors R1, R2 and R3 determine the biasing level. The value of collector current varies from 2.5 to 6 ma depending on the setting of R3. The normal operating value is 2.5 ma for maximum gain. A stand by receiver switch is incorporated in the emitter lead.

Mixer

The output of the rf amp is coupled to the mixer transistor TR2 (Philco T1833) by loosely coupling mixer coil L3 to amplifier coil L2 (see coil data for details). Capacitor C7 tunes coil L3 and the value of capacitor C8 is selected to match the input resistance of the mixer. The local oscillator power is injected

into the emitter terminals by returning the bypass capacitor C13 to ground through a tap on coil L8. An *if* frequency of 10-15 mc was selected. Coil L4 and capacitor C9 tune the collector output to this frequency range and the output is coupled to the load through coil L5 which is wound over the cold end of coil L4. The 3 db *if* response of the converter is about 3 mc. Since most of the activity is centered around 221 mc, the *if* response was peaked to 11 mc. The rf response at the mixer base is quite flat from 219.5 to 225.5 mc.

Emitter resistor R8 provides dc stabilization and resistors R6 and R7 determine the operating point.

Harmonic Generator

This section provides at least 180 millivolts rms of injection voltage to the emitter terminal of the mixer TR2 (Philco T1833). The local oscillator frequency is on the low side

PARTS LIST

C1=0.05 to 5.0 mmfd Piston Capacitor
C2=1.5-7.0 mmfd Ceramic Trimmer. (A fixed capacitor of about 2.5 mmfd can be substituted.)
C3=2.2 mmfd Ceramic
C4=4.7 mmfd Ceramic
C5=0.5-8.0 mmfd Piston Capacitor
C6=50 mmfd
C7=0.5-8.0 mmfd Piston Capacitor
C8=100 mmfd
C9=3 mmfd
C=10—1.0-18 mmfd Piston Capacitor
C11=1.0-18 mmfd Piston Capacitor
C12=0.5-5.0 mmfd Piston Capacitor
C13=0.01 mfd Ceramic 75V
C14=0.0015 mfd Ceramic stand off type.
C15=0.01 mfd Ceramic 75V
C16=470 mmfd Ceramic
C17=68 mmfd Ceramic
C18=68 mmfd Ceramic
C19=0.0015 mfd Ceramic stand off type.
C20=2.0 mmfd Mica
C21=5.0 mmfd Ceramic
R1=8200 ohms 1/2w
R2=2700 ohms 1/2w
R3=10,000 ohms Potentiometer
R4=470 ohms 1/2w
R5=820 ohms 1/2w
R6=15 K 1/2w
R7=4.7 K 1/2w
R8=1.5 K 1/2w
R9=8.2 K 1/2w
R10=3.3 K 1/2w
R11=1.5 K 1/2w
R12=39 K 1/2w
R13=4.7 K 1/2w
R14=470 ohms 1/2w
R15=39 K 1/2w
R16=4.7 K 1/2w
R17=470 ohms 1/2w

COIL DATA

L1—6 turns #20 tinned copper wire 3/16" I.d. 1/4" winding antenna tap 1 turn from ground end.

L2—3½ turns #26 tinned copper 5/32" I.d. ¼" winding length.

L3—4½ turns #24 tinned copper 5/32" I.d. ¼" winding length.
L2 and L3 form a double tuned circuit. Air wound in the same direction; spacing between coils as noted above.

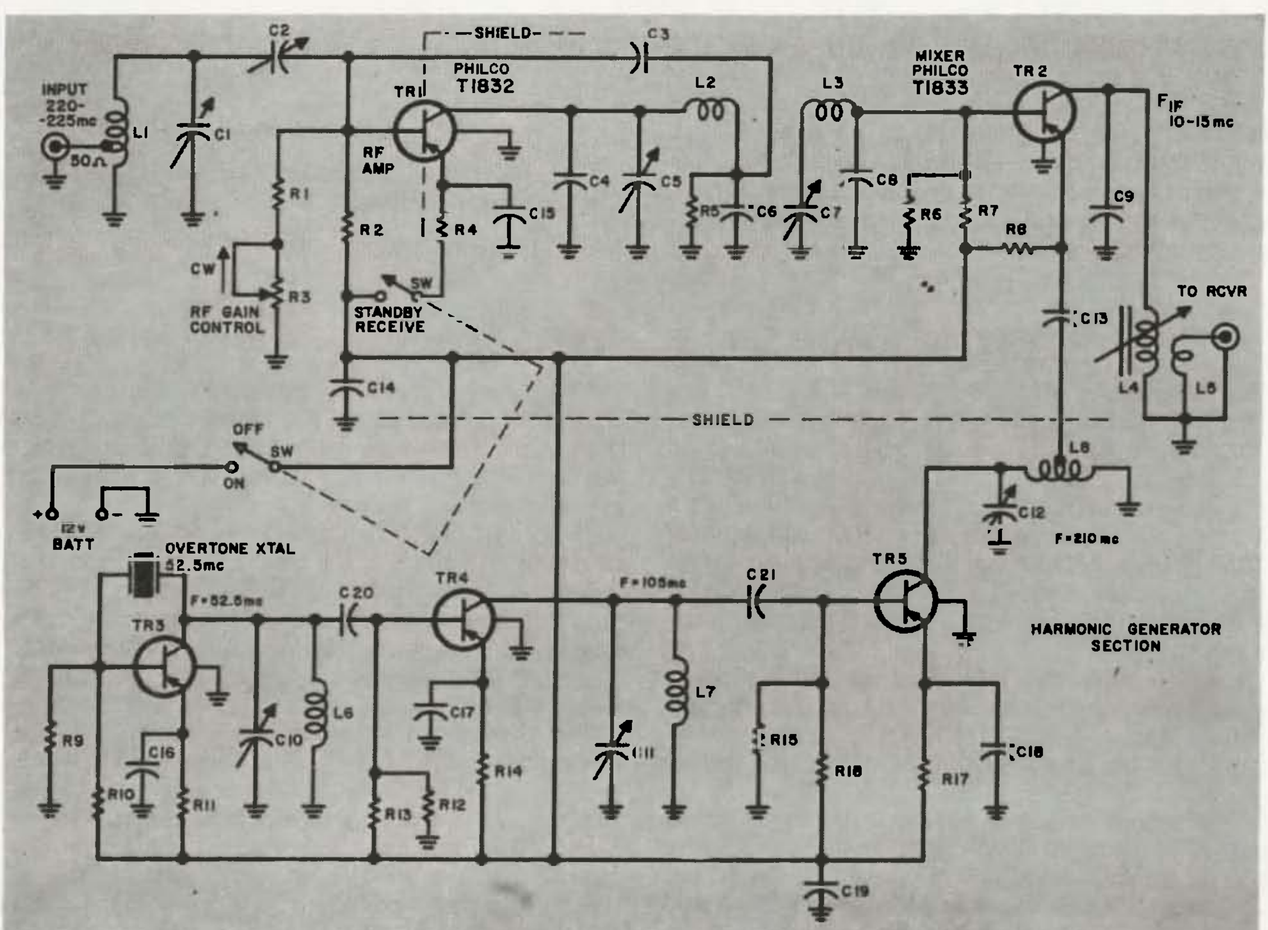
L4—72T #34 Nyclad copper wire close wound. W.L. about ⅝" on ⅜" ceramic form (Cambion type PLS-5 2C4L) powdered iron slug.

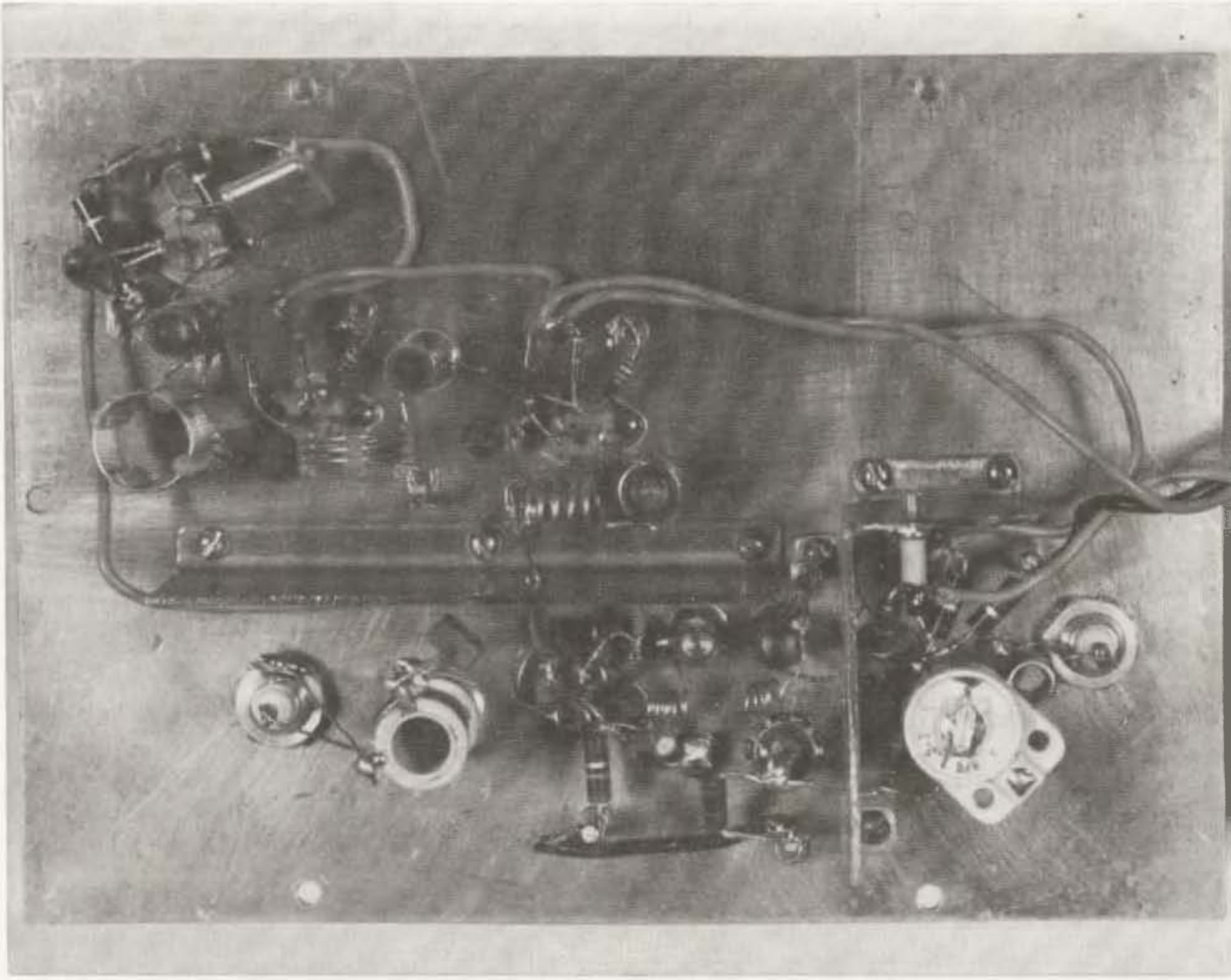
L5—15 turns #34 Nyclad copper wire close wound over ground end of L4.

L6—9 turns of #3003 Minductor (B & W) or air dux #416T.

L7—3 turns of #3003 Miniductor (B & W) or air dux #416T.

L8—5 turns #18 tinned copper wire ¼" I.d. W.L. = ½" tapped about ¼ turn from end.





and the output frequency is 210 mc. This high frequency output is obtained through the use of two stages of frequency doubling and a one stage overtone oscillator operating on a frequency of 52.5 mc.

Transistor TR3 (Philco T1859 or T1695) is used in the crystal controlled oscillator circuit. Coil L6 and capacitor C10 are tuned to 52.5 mc, the overtone frequency of the crystal. The oscillator output drives TR4 (Philco T1859 or T1695) through coupling capacitor C20. The output is tuned to a frequency of 105 mc by coil L7 and capacitor C11. The 105 mc output from frequency doubler TR4 is used to drive another frequency doubler TR5 (Philco T1859 or T1695) through coupling capacitor C21. The output frequency of TR5 is tuned to 210 mc by coil L8 and capacitor C12.

Emitter resistors R11, R14 and R17 provide the necessary dc stabilization and biasing resistors R9, R10, R12, R13, R15 and R16 determine the biasing current of their respective stages.

The actual collector current flowing in transistors TR4 and TR5 is influenced to some extent by the level of rf exitation from the oscillator TR3 since a combination of fixed and self biasing is employed in these stages.

Operation

The individual collector and total currents are tabulated below:

TR1	TR2	TR3	TR4	TR5	Total IC with divider current
2.5 ma	1.8 ma	2.0 ma	2.0 ma	2.0 ma	14 ma

The sweep generator method of alignment is suggested in tuning up the converter. However, the unit can be tuned up fairly well by peaking it up on a carrier from the transmitter or an rf signal generator.

If a variable capacitor is used for C2, alternately adjusting C1 and C2 for maximum output should peak the input properly. The point of best noise figure should coincide very nearly to the point of maximum power gain. The noise figure should be in the vicinity of 5.5 to 6.5 db.

The overall power gain is about 22.0 db. An additional 1.5 to 2.0 db can be realized by inserting a series tuned 11-12 mc trap between the mixer base and ground because the input circuit does not completely short the 12 mc input admittance of the mixer. It was felt that the additional tuning procedure involved did not warrant the addition of the trap. **73**

The RF Sniffer

Jim Kyle, K5JKX/6
1851 Stanford Ave.
Santa Susana, Calif.

EVERY now and then there's a need to know if any rf is present in a circuit. Frequency isn't so important—the question is simply. "Is there rf here?"

Your grid-dipper can frequently answer this, if used in the wavemeter mode, but occasionally it's not sensitive enough—particularly if you're working with a receiver oscillator where power is measured in microwatts.

Here's an rf Sniffer which will indicate the slightest trace of rf in a circuit. In addition to checking receiver oscillators, it's a perfect gadget to ensure perfect neutralization of a transmitter final.

Designed by W5JCB along classic lines, the Sniffer is built around a microammeter. While most 0-50 ma meters still bear price tags in the $15 region, an import stocked by Arrow Sales Inc., North Hollywood, Calif., and listed as their catalog number 606PM1, sells for only $5.95.

Using this meter, the total cost of the Sniffer should be less than $6.75 complete—the only other parts are a 1N34A diode and a .001 mfd capacitor.

Connect the components as shown in the schematic and photograph. Use long-nosed pliers as a heat sink between the diode and the solder joint when wiring, to prevent diode damage. Note that the pickup loop of 14 gauge wire is insulated with a strip of spaghetti.

That's all there is to construction of the Sniffer. Here are some of its uses:

Amplifier Neutralization—Couple the Sniffer to the antenna terminal with a temporary two-turn link around the pickup loop. Remove plate and screen voltage from the final amplifier. Apply drive. Adjust neutralization for minimum indication on the Sniffer—but don't expect to be able to get it down to zero.

Oscillator Checking—Place the pickup loop near the oscillator coil. If the oscillator's working, the Sniffer will indicate rf. Touching either the grid or plate lead (use an *insulated tool* for this test, not your fingers) should reduce the Sniffer's indication.

Receiver Troubleshooting—Check the oscillator as described above. If it's okay, next check the mixer plate coil by placing the Sniffer pickup loop near it. If you get an indication here, move to the first if stage and place the pickup loop near the plate pin of the tube socket. Proceed through the receiver until you lose the indication. The trouble is somewhere between the last indication and the point at which it disappeared.

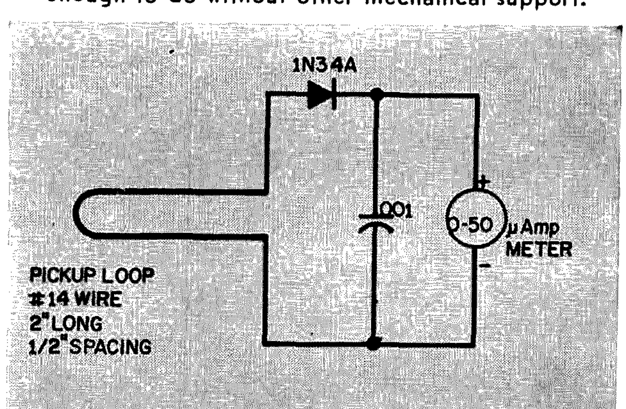
Field Strength Meter—Couple a short antenna to the pickup loop by two turns of wire around the loop. Field strength will be indicated in a comparative manner by the meter. It cannot be calibrated, but proves useful in tuning mobile or beam antennas, etc.

SWR Measurement—(Parallel lines only). Move the Sniffer long the line. Mark maximum reading and minimum reading over a half-wavelength. Divide minimum into maximum. The quotient is, roughly, your VSWR. This method is by no means exact, but will indicate whether the line is under or over a 2:1 SWR.

UHF Frequency Measurement—Set up Lecher wires. Couple the rf Sniffer lightly to the tank circuit instead of using a flashlight bulb. Use Lecher wires in normal fashion, reading Sniffer indications for maximum and minimum. This is much more exact than the normal methods.

Improvised Grid-Dipper—If you have a signal generator available, it can be used with the rf Sniffer to serve as a "grid-dip" meter to locate resonance for any tank circuit. Couple both the generator and the Sniffer lightly to the unknown tank. Vary generator frequency. A sharp rise in Sniffer indication indicates the resonance point.

Mount capacitor and diode on back of meter with shortest possible leads. Attach pickup loop directly to negative meter terminal; it's stiff enough to do without other mechanical support.



Balanced Modulator Dynamic Demonstrator

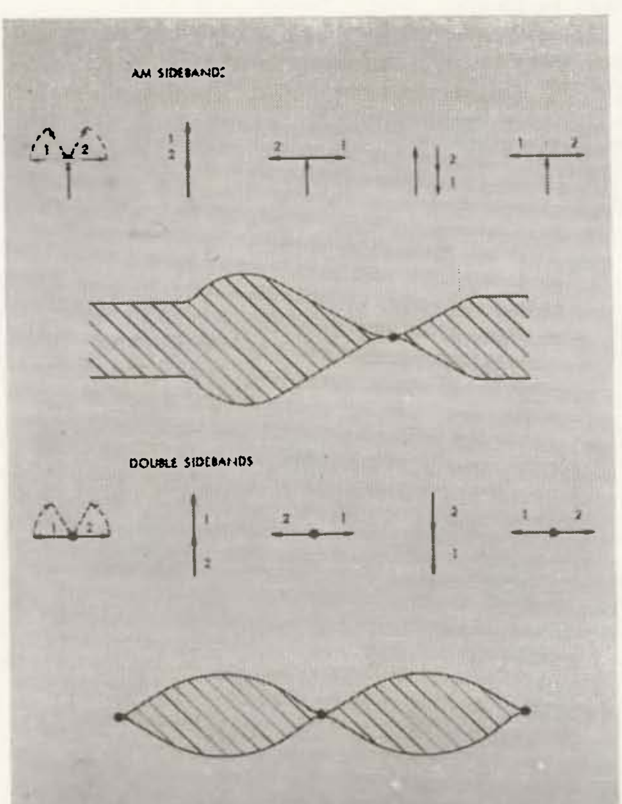
E. H. Sommerfield W2UQB
818 Wallace Street
Endicott, New York

There comes a time in every "ham's" life when he is called upon to impart to others his knowledge and experience on a given subject. This occurred to the writer recently when he was approached by "Doc"[1] W2JVZ, of the Greene Amateur Radio Society of Greene, New York, and invited to deliver a lecture on Balanced Modulators. Now one just does not get up before a group and point out a balanced modulator configuration and ask the listeners to accept the facts of carrier cancellation and sideband generation, neither does one go into a long series of vacuum tube equations. Its the correct mathematical procedure, but it's also a great cure for insomnia! No! The sensible approach is to analyze, via vectors, CW, AM, DSB and SSB, in that order, and demonstrate these forms of modulation on a dynamic demonstrator. This is the procedure the writer followed. After the talk the audience was invited to "twiddle knobs." As a result, an enjoyable and enlightening evening ensued.

The state-of-the-art of balanced modulators was examined to determine which circuit configuration would lend itself conveniently to the demonstration of all four of the aforementioned modes of modulation. It might be noted that CW is considered, by definition, a mode of modulation. The W2UNJ exciter was selected as a model for the following reasons:

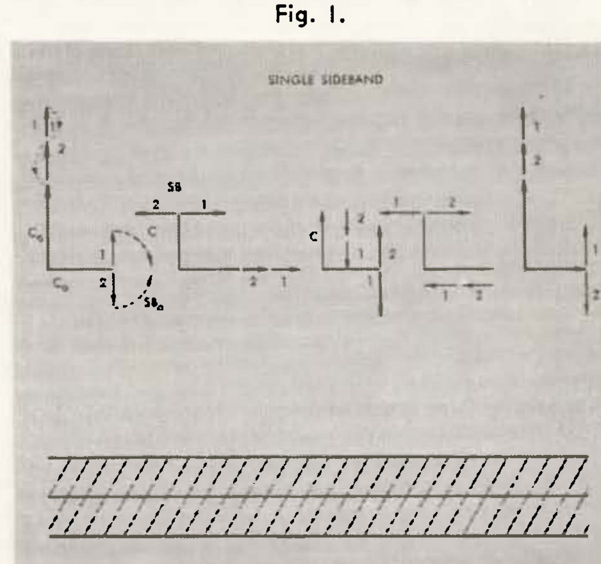
1. Each tube, or generator, could be applied to the tank circuit, or rf summing network, independently, without upsetting the other generators.
2. All terminals, input, output, and modulation were isolated from each other

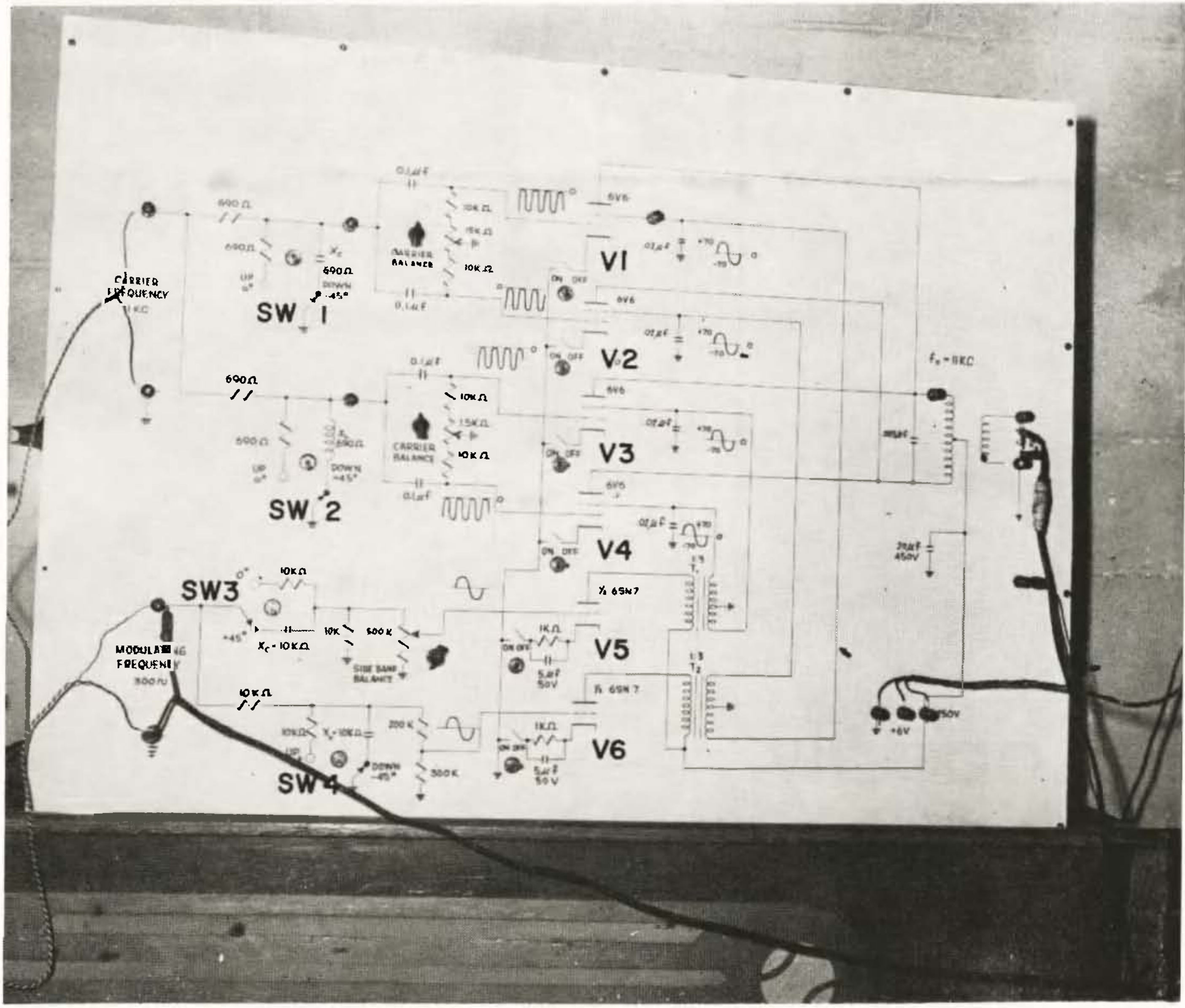
[1]Dr. Centerwall—W2JVZ



(*Note that since the screens of the carrier tubes are operated at ground, very little RF output is obtained; therefore, under AM conditions very low modulation is applied.)

Fig. 1.





preventing interaction between the different frequencies used.

3. Because of 1 & 2, audio frequencies could be used for both carrier and modulating signals. This permitted the use of long lead lengths necessary to physically mount controls and switches where the panel artwork directed.

If rf frequencies were used for the carrier, oscillation would have no doubt resulted. A single frequency was used for modulation with special emphasis being made that a phase shifting network, commercially available, would hold the phase difference, for the standard audio frequency range of 30-3000 cycles.

The circuit is shown in the attached photo. With the exception of the modulating phase shift networks, it is identical to the W2UNJ exciter described in many previous ARRL Handbooks. Although the overall circuit theory has been adequately covered in the previously mentioned handbooks, some circuit information was gained by noting the results obtained when the different generators were connected onto the tank circuit.

Abnormal operation can be displayed in SSB by switching S_1-S_4 (one at a time) to 0° and noting the increase in output ripple that occurs from the appearance of the unwanted sideband.

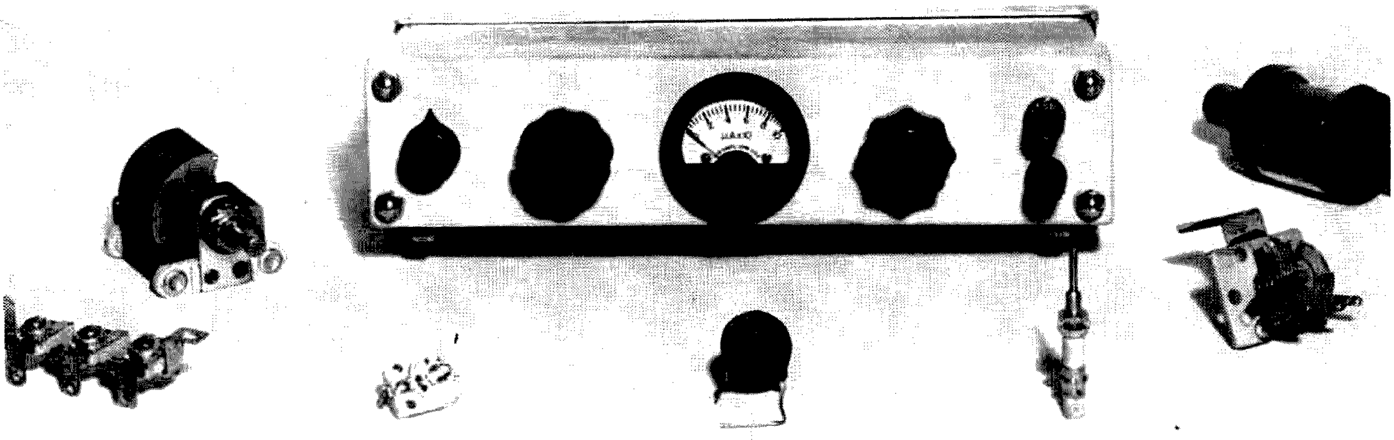
Before each mode was presented, Figure 1 displayed on large charts were referred to. to explain the theory.

An effort was made, at the conclusion, to point out the advantages of both DSB and SSB as a modes of modulation insofar as overall communications efficiency is concerned. Also, mention was made of the newer and more efficient balanced modulator configurations.

Although crude perhaps in its pedagogical approach, the effectiveness of this method of lecturing can be attested to by the number of additional invitations received to repeat it. 73

Table I describes the conditions of the various generators for the different modes of modulation.

Mode	V_1	V_2	V_3	V_4	V_5	V_6	SW_1	SW_2	SW_3	SW_4
CW	—	—	ON	—	—	—	0°	0°	0°	0°
AM	—	—	ON	—	ON·	—	0°	0°	0°	0°
DSB	—	—	ON	ON	ON	—	0°	0°	0°	0°
SSB	ON	ON	ON	ON	ON	ON	—45°	+45°	+45°	—45°



Capacity Meter

... Second only in usefulness to the GDO

Tom Lamb K8ERV
1066 Larchwood Road
Mansfield, Ohio

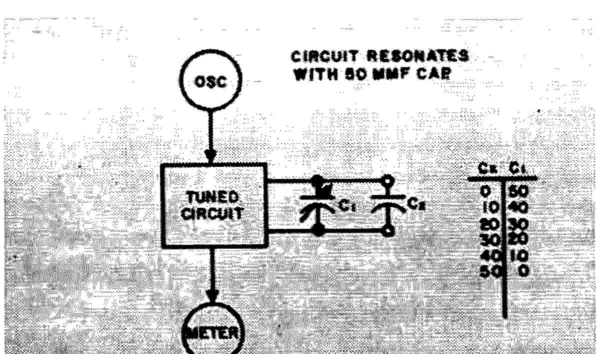
MEASURING variable or small unmarked capacitors is often a major problem. The Grid Dip Oscillator method is inconvenient and often more work than it is worth. The meter described will measure O-40 mmfd and O-900 mmfd in two ranges, and will resolve one mmfd on the low range.

The operation is shown in Fig. 1. A coil is tuned to resonate at one mc by two capacities, C1 and CX. An oscillator excites the circuit at one mc. and an rf voltmeter indicates resonance. Assume the circuit resonates with a total capacity of 50 mmfd. If there is no CX connected, then C1 must be 50 mmfd. to resonate. If an unknown capacity is now connected, C1 must be reduced exactly the amount of CX to bring the circuit back to resonance. If C1 is calibrated, the value of the unknown is indicated directly on the C1 dial.

This process is called capacity measurement by substitution. The unknown substitutes for an equal amount of capacity in the calibrated variable. This method has several important features. First, and most important, the accuracy and long time stability depend only on the calibrated variable condenser. Drifts in the battery, oscillator, and inductances will not affect the instrument. Second, the meter is unaffected by the hum pickup that often plagues homemade bridges. Third, condensers that are lossy at radio frequencies can be detected. Fourth, it is easy to measure capacities at the end of a long, high-capacity cable.

Fig. 2 shows the complete circuit. A simple transistor oscillator drives the tuned circuit

Fig. 1—Capacity measurement by the substitution method.

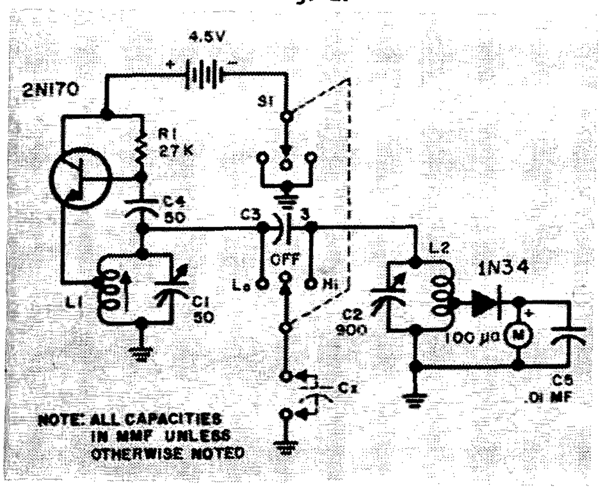


L2C2 through a small coupling condenser. A diode voltmeter indicates circuit resonance by a maximum reading. The operating frequency in my case was 1450 kc, but is not critical so long as the L1C1 and L2C2 circuits resonate at the same frequencies with C1 and C2 at maximum capacity. I suggest that L2 be duplicated and L1 be adjusted as described later. The leads to C3, S1, and the CX terminal should be short and spaced away from ground to reduce stray capacity in this part of the circuit.

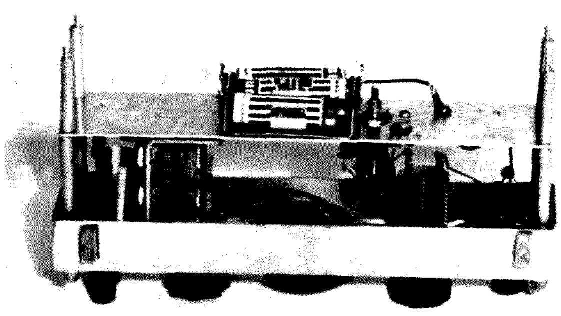
Adjustment

Turn S1 to the "Hi-C" position and set C1 and C2 to maximum. Adjust the slug in L1 for a maximum meter reading. (If no read-

Fig. 2.



ing is obtained, either the oscillator is not operating or it is not tuning to the frequency of L2C2.) The meter reading should be sharp but smooth as L1 is tuned. If C3 is too large, the meter will umjp, due to the two tuned circuits interacting. If C3 is too small, the meter indication will be low. In my case the maximum reading was 20 μa.



Now switch S1 to "Lo-C" and reduce C1 to again peak the meter. The difference in the two C1 settings is due to stray capacity in the instrument. The meter is now ready for calibration.

Calibration

Turn S1 to "Hi-C" and set C2 to very near its maximum capacity. Mark the C2 dial "O." Peak the meter with C1., which becomes the calibration or zero adjustment for the C2 dial. Now place known capacities across the CX terminals, and peak the meter with the C2 dial. Mark the known values on the C2 dial. The maximum capacity that can be measured is the value of the maximum capacity of C2.

Small capacities are substituted in the oscillator circuit which, because of its lower operating capacity, gives a more spread out scale. Set C2 at its zero mark and switch S1 to "Lo-C". Peak the meter with C1 and mark the C1 dial "O". Place small known capacities on the CX terminals and calibrate the C1 dial. The C2 dial now becomes the zero adjustment for the low capacity scale. The maximum capacity readable on the C1 dial will be less than 50 mmfd because of stray capacities.

Operation

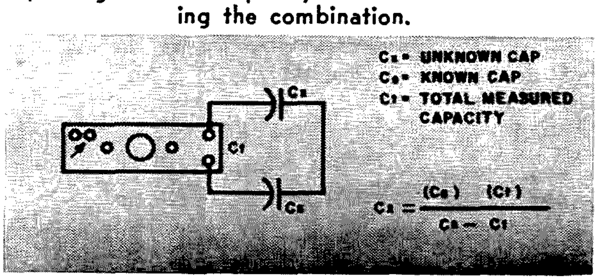
To operate the capacity meter, simply set the scale in use on zero and peak the meter with the other dial. Add the unknown capacity and re-peak the dial in use and read the unknown capacity.

Capacities above the range of C2 may be measured by placing them in series with a known capacity of about 1000 mmfd and reading this combination. The unknown may then be calculated as shown in Fig. 3. If desired, a second scale could be calibrated on C2 for use with a particular series condenser.

At resonance the total capacity tuning L1 and L2 do not change between the zero and measure adjustments. Therefore the meter readings should be exactly the same. A high Q (low loss) condenser will not affect the meter reading, but a low Q unit will decrease the reading. Generally, any condenser that affects the meter reading should not be used in a high Q or tuned cricuit.

This meter has been in use for two years and is second only to the GDO in usefulness around the shack. 73

Fig. 3—A large capacity can be measured by placing a known capacity in series and measuring the combination.



Station Control System

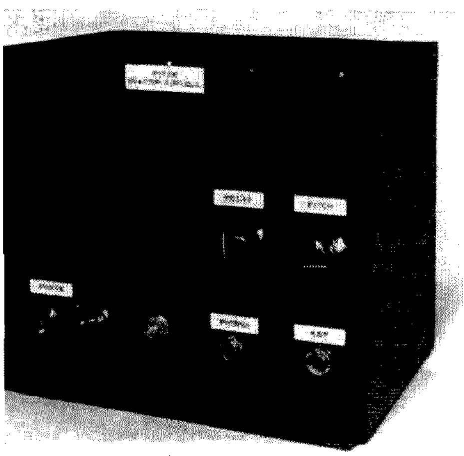
David L. Cabaniss, W1TUW
113 George St.
Bristol, Conn.

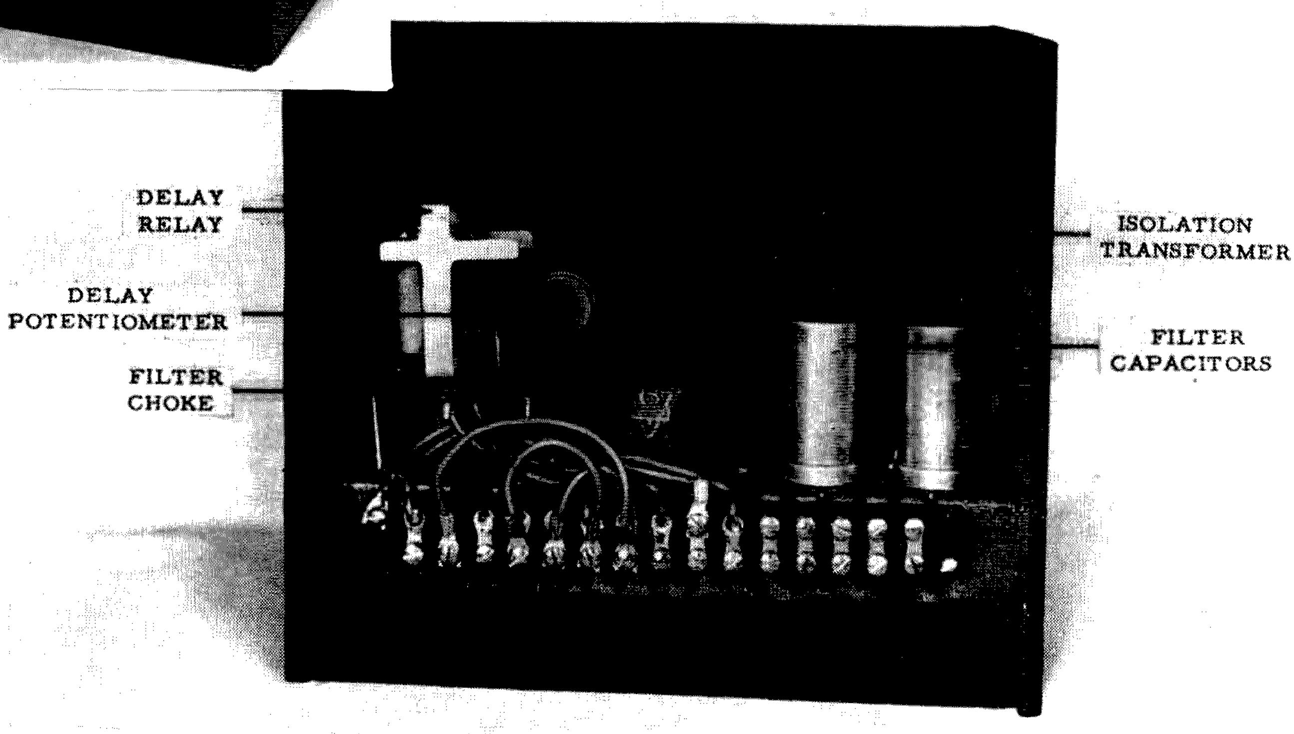
THIS article is not directed at the amateur who has everything! It is, however, directed at those who like to tinker, etc., and find out just what can be done with all that extra junk hanging around the shack. The offspring of my junk box is shown in the photograph: a simple, cheap and easy way to convert your "push-to-talk" phone station into a "press-the-key-to-transmit" CW station, without the necessity of tearing apart all that gear that is operating so well at the moment."

All types of control systems have good and bad features. None of the systems described in the well known amateur publications depicted the type of system that I was looking for, so I decided to build my own, using a combination of many ideas that are well known in amateur circles. Of course, one of the prerequisites of the unit was that it had to be built entirely from the junk box.

The entire Station Control Unit was built on the chassis of an old ac-dc set. The panel is bakelite, and the cabinet is made of wood.

Referring to the circuit diagram it will be noted that the power supply is a standard ½ wave rectifier type, providing 115 v dc, isolated from the line. I happened to have an old isolation transformer but two filament trans-





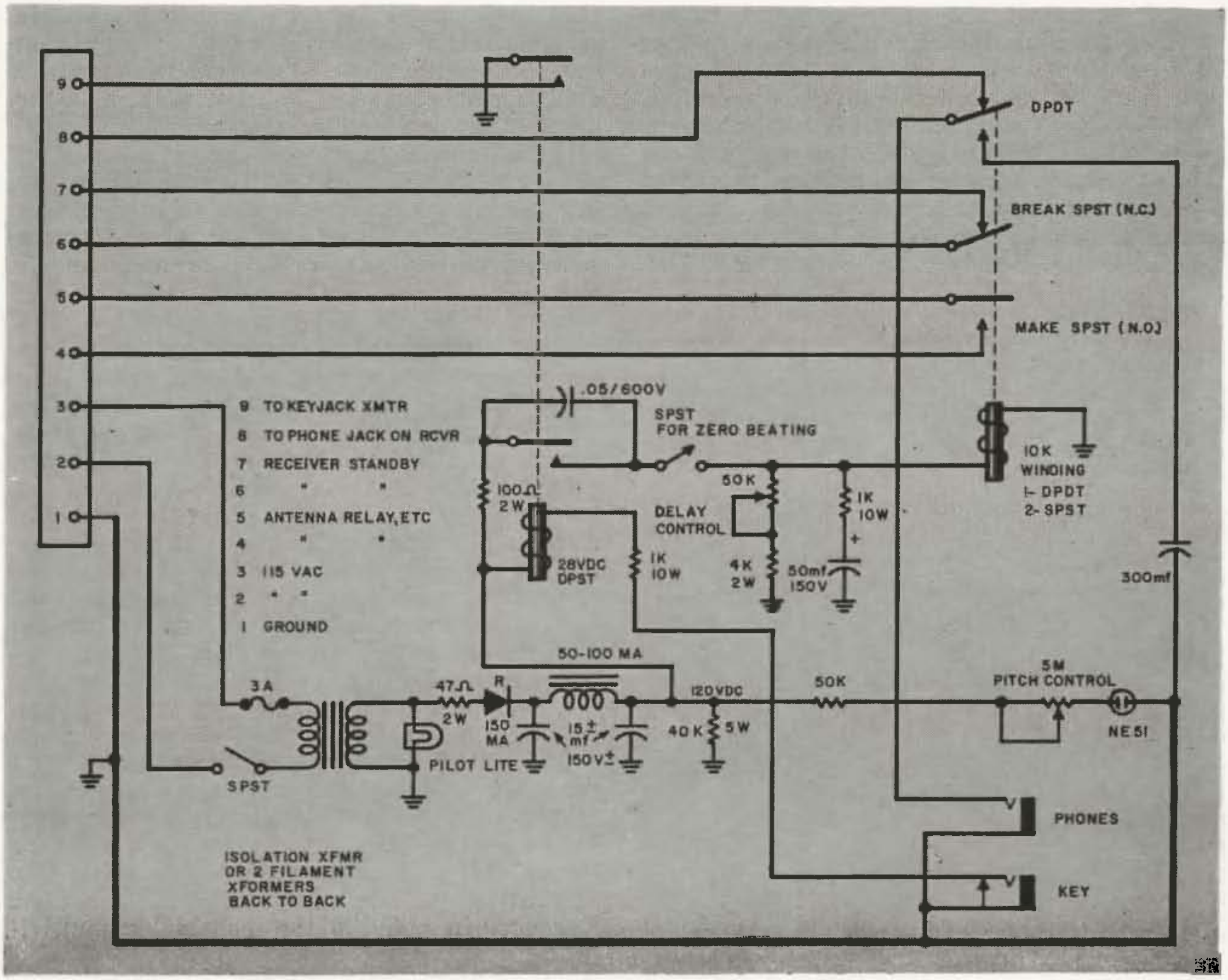
formers back to back will work just as well. The keying relay used in this particular unit is the 28 v dc cathode keying relay stolen from an old ARC5 transmitter. The delay relay has a high impedance winding and has contacts for controlling the station equipment (any high impedance relay will operate satisfactorily). With the components shown in schematic diagram the delay can be varied from .5 to 2.5 seconds.

The circuit is simple enough so that a complete explanation is not required (*see Qst June* 1959—*Page* 27.) Basically, when the key is closed one set of contacts on the keying relay keys the transmitter (through the regular transmitter key jack). The other set of keying relay contacts connect 115 v dc to the delay circuit; the delay relay closes immediately, turning on the transmitter high voltage and putting the receiver in standby position, or performing other functions, depending upon where the delay relay contacts are connected. (In most applications, the delay relay contacts should be connected to the push-to-talk circuit.) When the key is released, the keyed circuit in the transmitter will open. However, the delay relay will not open immediately, due to the charge on the electrolytic connected across the coil of the delay relay. Thus all circuits are kept in the transmit position. When the key is again pressed to start the next character, the keying relay again closes, keying the transmitter circuit and replenishing the charge on the electrolytic capacitor across the delay relay coil. From this point on normal keying takes place. When keying is stopped (at the end of a transmission), the delay relay will stay energized until the electrolytic capacitor discharges. The amount of time required to discharge the capacitor will depend upon the setting of the Delay Control potentiometer (50K ohms). When the delay relay releases all station circuits will return to the "receive" position.

To allow zerobeating a SPST toggle switch was inserted in the B plus line to the delay relay allowing the transmitter oscillator to be keyed with the receiver on.

After the unit has been constructed and put into operation, any large arc appearing at the keying relay contacts should be suppressed by the addition of a .05 mfd capacitor across the contacts keying the delay circuit.

The unit described in this article has been in operation for over a year now and has provided hours of enjoyable cw operation. **73**



The Multivibrator in Amateur Vox Circuitry

Roy E. Pafenberg
P. O. Box 844
Fort Clayton, Canal Zone

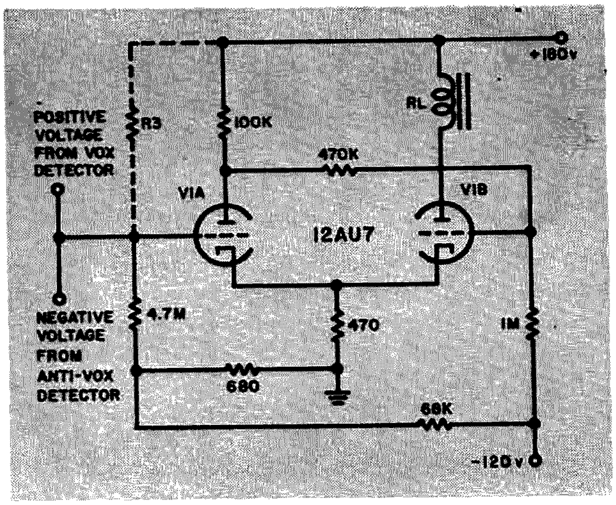
Pulse Circuits are Adapted to Provide Superior Performance in this Critical SSB Application.

If any single feature of Single Sideband operation has contributed most to the justly earned popularity of this spectrum saving mode of transmission, it is the talk-to-talk or VOX convenience incorporated in most such transmitters. Also, in the opinion of the writer, this is the area of greatest technical deficiency in many home built and commercial rigs.

Most circuits for this application consist of a diode to rectify the control voltage and a simple dc amplifier to actuate the transmit-receive relay. An RC network is inserted between the detector and the amplifier to hold the relay closed between normal pauses in speech. Anti-VOX may be added by rectifying the audio output of the station receiver and applying an equal and opposite voltage to the input of the dc amplifier, thus preventing actuation of the VOX by the receiver speaker. Although the dc amplifier is usually driven into saturation by the control signal, circuit performance is strictly at the mercy of the relay until the output stage current exceeds the normal operating current rating of the relay winding. Most relays, in the range of current between the release and operate points, are more or less erratic and unpredictable in operation. It is extremely difficult to manufacture a relay that will meet specifications as to shock, vibration and orientation, in both operated and nonoperated conditions, and at the same time exhibit completely reliable and predictable performance from zero to rated maximum winding current. Further, the rise time of an integrated dc voltage, derived from random speech, may be relatively slow. This results in considerable dwell time in this unreliable area of operation.

One apparent solution to this problem is to drive the relay with a fast acting electronic switch. This switch must have smoothly and precisely adjustable sensitivity, long term stability, and the output must be an unequivocal on or off. Fortunately, just such a device is available and, while not widely used in this application, is admirably suited to the task. The case in point is the monostable multivibrator.

Fig. 1A. Schmitt trigger relay circuit provides greatly improved operation. Note 1: Insert resistance in series with RL, if required, to provide a 10,000 ohm plate load. Note 2: Add R3 for negative VOX, positive anti-VOX control. Adjust value downward to point where relay opens with no control input.



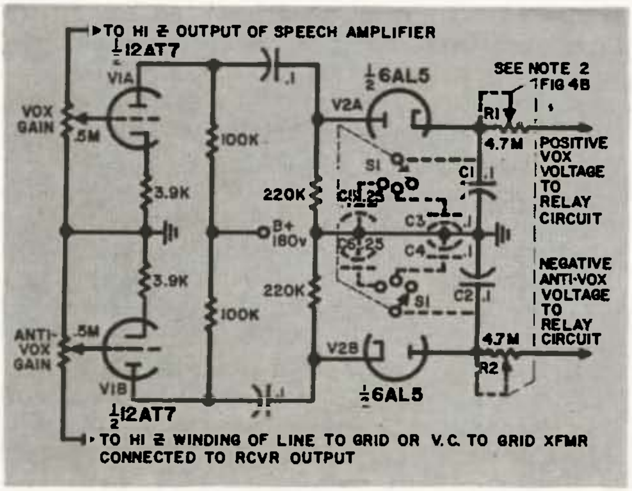


Fig. 1B. Suggested audio and detector circuit for the Schmitt trigger shown in Fig. 1A. Note 1: If variable C adjustable delay is desired, change C1 and C2 to .05 mfd and add C3, C4, C5, C6 and S1. Note 2: If variable R ad justable delay is desired, change R1 and R2 to 10 megohm dual potentiometer. The fixed values shown for C1, C2, R1, E2 provide optimum recovery delay.

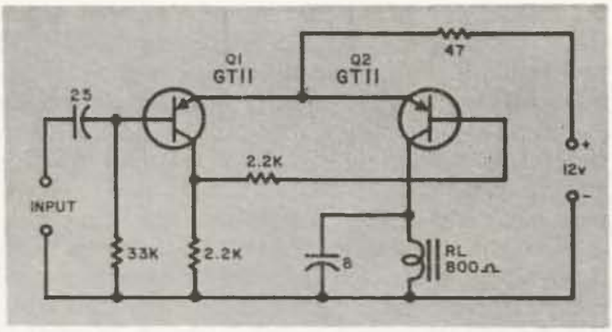
While the basic circuit has many variations, the most suitable of these is the Schmitt trigger. The output of this circuit has two states, either cutoff or saturation, while the input possesses a selective or slicing characteristic. That is, when a signal or control voltage below a precisely determined trigger point is applied, there is no change in output. When the control voltage exceeds this point, the output stage triggers from cutoff to saturation. The circuit switches back to its quiescent condition when the control voltage falls slightly below the operate point. There is no appreciable in-between condition as the switching time is measured in microseconds. All of this is obtainable at no additional cost, since the component requirements of the Schmitt trigger are less than those of many dc amplifier circuits. Further, a very sensitive or high quality relay is not necessary. Almost any relay will do, so long as it has the required number of contacts and its operating current approximates the saturation current of the output stage.

Practical testing now appeared in order, so a speech amplifier and VOX assembly, using the circuit shown in Fig. 1A, was constructed for use in a surplus conversion project. With the configuration selected, the output stage is normally saturated and a positive control voltage is required to switch the Schmitt trigger circuit. The device functioned perfectly, switching reliably on 3 volts dc and switching back when the VOX voltage fell slightly below that point. A positive voltage applied to the grid of V1A causes a drop in the plate potential of that stage. This plate is coupled to the grid of V1B, which is normally clamped at cathode potential. The plate current of V1B decreases, thus the cathode potential drops and the grid potential of V1A increases. The action is regenerative and V1B rapidly cuts off. Lowering the applied bias signal to a point slightly below the trigger voltage causes a reversal of this action. With the control voltages available, it was more convenient to return the input grid to a slightly negative point and to use a positive voltage to switch the stage. If the reversed relay operation is considered objectionable, simply add the bias resistor shown in dotted lines and a negative signal will saturate the output section of V1, although a slightly greater control voltage will be required. The improvement of this circuit over the conventional dc amplifier type of voice control is remarkable. No attempt was made to further optimize the circuit since operation, with values shown, was satisfactory in every respect.

Input and detector circuits suitable for use with this Schmitt trigger relay are shown in Fig. 1B and are typical of those normally used in this application. The VOX gain control is advanced until the unit is tripped by normal speech. Since the relay circuit operates on a "slicing" principle, considerable delay or recovery time adjustment may be obtained by varying the VOX gain between the points where normal speech trips the relay and ambient room noise causes operation. The theory of this is simply that the more the rectified control voltage exceeds that required to operate the relay, the longer it takes that voltage to decay to the point where the reverse operation occurs. After adjustment of the VOX gain, the Anti-VOX gain should be advanced to the point where normal speaker level will not trip the relay.

If the range of delay adjustment is not considered adequate, the values of R1 and R2 *or* C1 and C2 may be simultaneously changed to

Fig. 2. Transistorized multivibrator relay circuit provides reliable switching with very low level audio input.



Compact, transistorized multivibrator controlled relay assembly. The complete switching circuit is shown here.

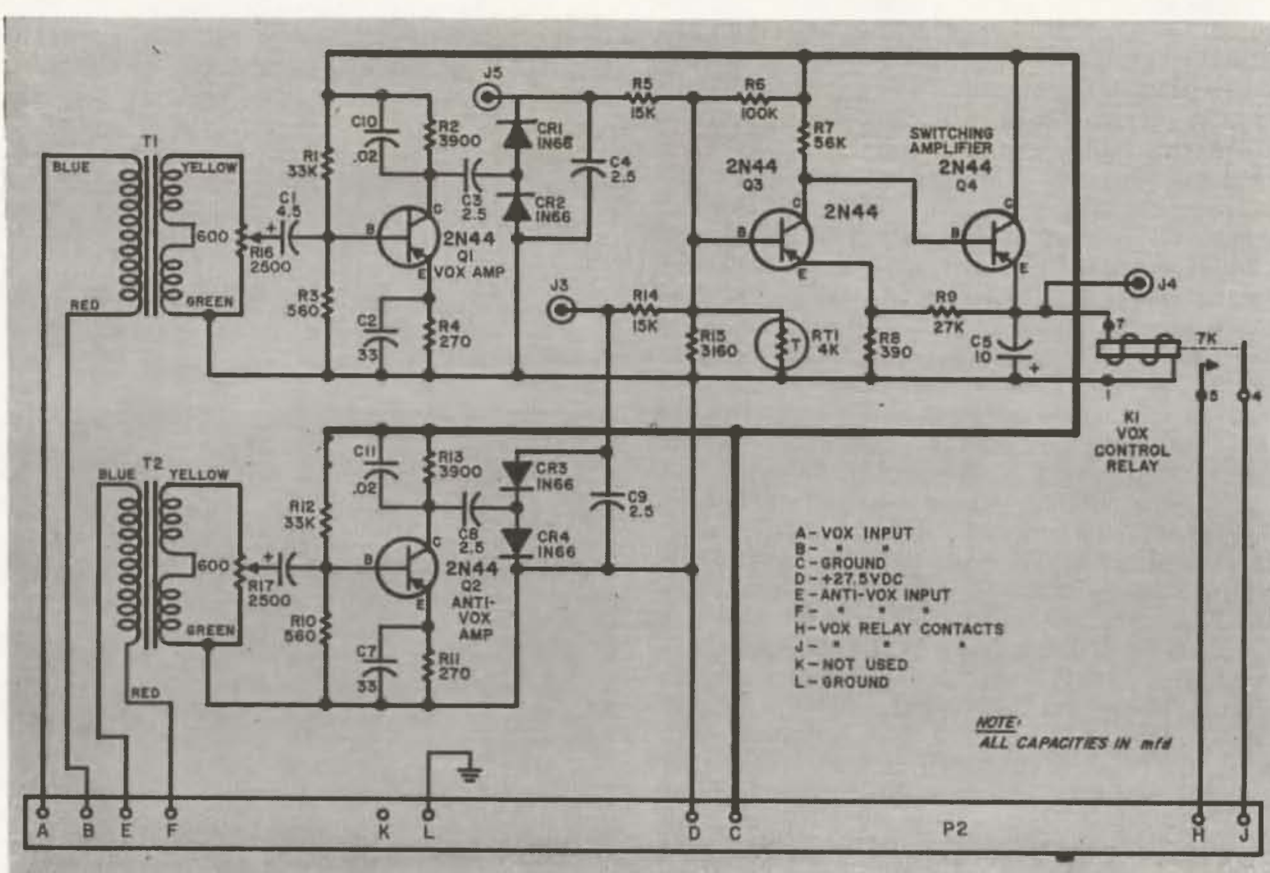
covery time is required, either the R or C option of Fig. 1B may be installed. Replace R1 and R2 with a 10 megohm dual potentiometer or install the capacitor switching network shown.

Transistorization

Having confirmed that use of the multivibrator in vacuum tube VOX circuits offered the apparent advantages, attention was turned to the use of transistors in this application. The writer desires to construct a fully transistorized SSB exciter with all of the operational features and performance characteristics of the better available commercial equipment. The following material was gathered for the preliminary design of the VOX circuit of this future project.

The use of a transistorized monostable multivibrator for relay control is not new. Such a circuit was featured in an article, "Multivibrator Operates Relay", by G. B. Miller, and published in the December 5, 1958 issue of "Electronics". While the circuit, reproduced in Fig. 2, was designed to function with an ac switching signal, the basic slicing action with the attendant advantages is present. While it might appear that an ac operated relay would be ideal for VOX switching, this is not necessarily true. While it functions perfectly in the VOX action, the integrating characteristic of the circuit makes the application of the Anti-VOX signal a difficult task. This emitter-coupled circuit is of interest in such applications and its performance is remarkable. If the Anti-VOX feature is not required, this circuit is a good, clean solution to the problem. Switching is obtained with an input signal of about 10 millivolts from a 10 ohm source and the circuit switches back when the signal drops slightly below this level. One additional advantage accrues in the use of multivibrators in

Fig. 3. Vox Anti-Vox module of the Collins Radio 786F-1 Sideband Generator. This portion of the 310F-6E Exciter illustrates a commercial application of transistorized voice control switching circuitry.



transistorized switching circuits. A transistor is capable of switching power far in excess of its Class A amplifier rating if the transition time between cutoff and saturation is very short. Therefore, any circuit that would permit the output stage current to dwell at some point between cutoff and saturation would greatly increase the output stage power handling requirement. If the relay recovery time is too short, the value of the capacitor shunting the relay may be increased in value up to several hundred percent without adverse effects.

Collins Radio in one of their "firsts" has used transistorized switching amplifiers in their military/commercial 310F-6E High Frequency Communications Exciter. The circuit, courtesy of Collins Radio Company, is shown in Fig. 3. Another feature contributing to the performance of his unit is the use of a voltage doubler configuration in the VOX and ANTI-VOX rectifier circuits. This technique is particularly valuable when using transistors, since the required voltage swing may be difficult to obtain without using special transformers. In any event, this circuit is seeing increasing use in receiver AGC and transmitter ALC applications.

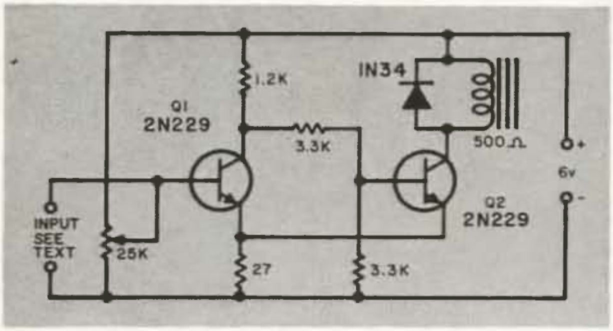


Fig. 4A. DC version of the transistorized multivibrator relay switching circuit.

The device shown in the photograph was constructed to test the ideas generated by this approach. The circuit, shown in Fig. 4A, was adapted from a circuit described in the Sylvania manual, "Performance Tested Transistor Circuits". The potentiometer in the input circuit is a change from the original bias network and permits setting the input stage bias for best operation. No real attempt was made to miniaturize the circuit, since the relay, the only one immediately available, was the limiting factor. Actually, the circuit is very noncritical and almost any general purpose NPN transistor may be used. If the battery and diode polarities are reversed, PNP transistors will serve equally well.

Base bias of the input transistor is initially set slightly below the point where the relay operates. In this condition, Q1 conducts and Q2 is cutoff. As the base bias of Q1 is reduced by the rectified control signal, the collector

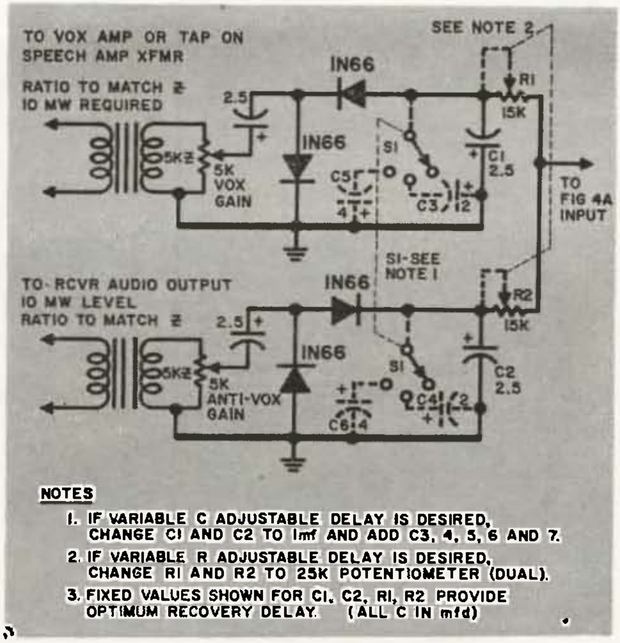
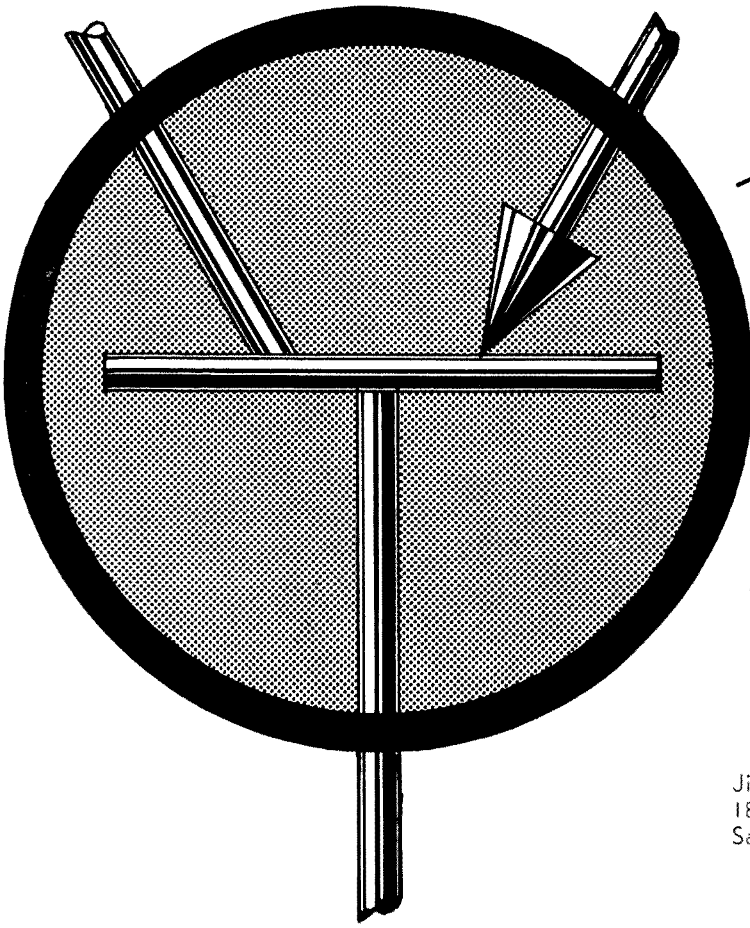


Fig. 4B. Suggested input and detector circuit for the transistorized relay shown in Fig. 4A.

current is reduced and the collector voltage rises. This rise appears at the base of Q2 and when it reaches a critical value, Q2 conducts, switching the multivibrator. Relay current under these conditions is either negligibly small or, for all practical purposes, infinitely large. Therefore, positive, fast relay action is obtained with only a few millivolts variation in input signal. Desired operating delays in relay action may be achieved by altering the time constant of the RC network in the VOX and ANTI-VOX control signal rectifier circuits. Starting point values for this application may be found in Fig. 3. Since the detector circuits of Fig. 3 are designed for use with PNP switching transistors, the VOX and ANTI-VOX inputs of Fig. 3 must be reversed to permit use with the NPN switching circuit of Fig. 4A.

The information presented herein was developed to meet the previously described specific requirements and it is believed that the objectives have been realized. The results warrant more general application of this type control circuitry and, while certainly not in finished construction project form, this data should be of considerable value to anyone embarking on a similar project.

The same considerations, with respect to recovery time delay, that were described with reference to Fig. 1A and 1B apply to the transistorized version. Fig. 4B shows suitable input and detector circuits for use with the relay unit shown in Fig. 4A. If the recovery time delay of the circuit, using values specified, is not acceptable, alter R1 and R2 *or* C1 and C2 for the desired time constant. If adjustable recovery time is desired, replace R1 and R2 with a dual 25,000 ohm potentiometer or install the capacitor switching network shown.



The Fine Art of Transistorizing

Jim Kyle K5JKX/6
1851 Stanford Ave.
Santa Susana, Calif.

SMALL, lightweight, low in power requirement . . . the transistor requires no sales talk to most hams. Dozens of amateur designers over the country are busily converting tried-and-true vacuum-tube circuits to use the super-duper semiconductor, while others are developing new circuits.

However, there are tricks to all trades—and the fine art of transistorization is no exception. The purpose of this article is to outline the general procedure for conversion of vacuum-tube circuits to employ transistors, and to point out some of the tricks along the way.

Many designers, faced with the problem of transistorizing a tube circuit, simply plug in semiconductors in place of tubes, change some parts values to take into account the differences of impedance involved, and hope for the best. They seldom achieve it, although their circuit will usually work.

As a matter of fact, this approach is just about the only starting point for conversion of a vacuum-tube circuit. The major thing to keep in mind is that it's just that—a starting point, not an end product.

To employ this technique (if I may repeat some hoary truths from the basic transistor books) all you have to do is remember that the base of the transistor corresponds to the grid of a triode tube; the collector corresponds to the plate, and the emitter to the cathode.

Like tubes, transistors must be properly biased for the desired operating point. To continue using the "tube" analogy, the collector (plate) to emitter (cathode) circuit must be reverse-biased, while the base (grid) to emitter (cathode) circuit must have forward bias.

In the beginning, an easy way to remember what is forward bias is this: Consider "P" and "N" in the transistor type designation as the initials of "positive" and "negative" respectively. When a positive voltage is connected to a P element and the voltage is returned to the emitter, the element is forward biased. If a negative voltage is connected to a P element and returned to the emitter, the element is reverse-biased.

If you're using NPN transistors, polarity of the supply voltages will be the same as those used with vacuum tubes: the collector must be positive and the emitter negative. However, the base (grid) voltage will be opposite to that of a tube—it must also be positive.

Naturally, polarity of supply and bias voltages will be reversed with PNP transistors (the most common type).

Much has been said about the "extremely" low impedance of transistors as compared to

tubes. While semiconductor devices do have lower impedance than their tube equivalents, the difference is not so great as many may believe.

The reason behind the publicity about "extremely" low impedance is this: most early transistor work was done with the grounded-base circuit.

Looked at as a tube substitute, this makes it a bit more clear. The input impedance of a grounded-grid circuit is only about 75 to 100 ohms when a vacuum tube is used.

And in comparison, the 50-ohm average value of input impedance for a grounded-base transistor amplifier isn't so extreme, after all.

Actually, most transistor circuits exhibit impedances approximately 100 times less than their tube equivalents. If you used a 270,000-ohm plate load resistor in the tube circuit, try a 2,700-ohm unit in the transistor version. This rule is barnyard-broad, but will at least give you a starting point for experimentation.

One of the major differences between transistors and vacuum tubes is the fact that transistors are operated by current, not by voltage. Tubes, on the other hand, are primarily voltage amplifiers and any current gain is secondary.

This leads to the concept of "duality," which you'll find many words about in any semi-advanced transistor text. They won't be repeated here, except to say that the "dual" of any circuit element is some other circuit element which responds to current in the same manner that the original element responded to voltage. For instance, the series-resonant circuit is the dual of the parallel-resonant circuit, because current flow is high at resonance in the series circuit while voltage is high at resonance in the parallel case.

The amateur designer has little need for the "duality" concept, however. The time spent learning more about it will be put to better use discovering the circuits which are peculiar to transistors only and which have no vacuum-tube equivalents.

The most famous of these, of course, is the amplifier hookup which bears the lengthy title of the "complementary symmetry" amplifier. It provides push-pull amplification without any phase inverter, and has no equivalent in tube circuitry, since nobody yet has built a tube which operates with the plate negative and the cathode positive.

Basically, the amplifier consists of identical class B single-ended amplifiers connected with inputs in parallel and outputs in push-pull. The only difference between the amplifiers is that one uses a PNP transistor, and the other an NPN. Such a circuit is shown in Fig. 1.

Any signal which tends to increase forward bias on the transistor causes an increase in collector current. Therefore, the positive peaks of the input signal are amplified by the NPN transistor, and the negative peaks by the PNP.

Any signal which reverse-biases the base cuts the collector current off. Therefore, positive peaks cut off the PNP unit and negative peaks cut off the NPN. Bias conditions for the bases are chosen to minimize crossover distortion, and the result is a push-pull amplifier without phase inverters. The major disadvantage of the circuit is that it requires separate power supplies for each half of the amplifier.

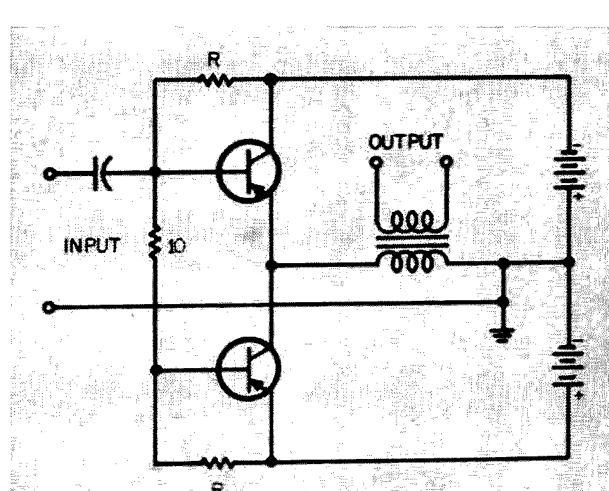
The amplification property just mentioned —forward base bias resulting in greater collector current while reverse bias cuts the unit off—leads to another important circuit which is peculiar to transistors: the switch.

If a transistor is hooked up as shown in Fig. 2, with the base open-circuited and a load in the collector circuit, the transistor will appear to be an open switch so far as the load is concerned. No current can flow through the collector circuit.

However, application of forward bias to the transistor will reduce its collector-emitter resistance to less than 100 ohms (less than one ohm, in many cases) and it will then look to the load like a closed switch.

Since the collector current in the average experimenter-quality transistor can run as high as 50 ma, and rated current for more-expensive units runs into the amperes, the transistor is a simple substitute for the power relay. In addition, a current measured in microamperes is injected into the base to turn the unit on, while the load may take several amps.

Fig. 1—The complementary-symmetry amplifier shown here produces push-pull action without phase inverters. Values of resistors R are chosen from published data on the transistors chosen for the circuit. Input capacitor C must be chosen for best low-frequency response. Its value will be in the neighborhood of 25 mfd. in most cases. The transformer is chosen from power amplifier design charts such as those shown in the GE Transistor Manual. A 16-ohm speaker may be substituted for the transformer if desired.



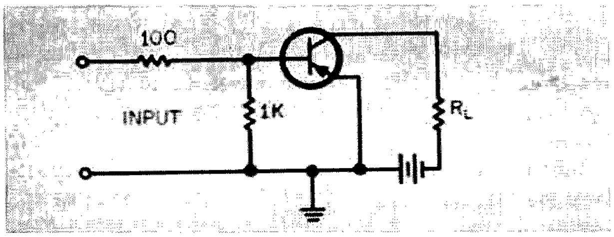


Fig. 2—The transistor switch circuit controls a load current which may range up to several amperes and requires only microwatts of input power. The 100-ohm series base resistor is to limit current to a safe value, while the 1000-ohm resistance from base to ground limits "off" current to a low value. Value of resistor RL is determined by the power rating of the transistor. For a 2N107 operating from a 9-volt battery, RL should be approximately 6,000 ohms.

The switching circuit, though, isn't confined to the handling of power. Take, for example, the FM limiter. If a sine wave is applied to the input of a transistor switch, a clipped sine-wave output will be obtained at the collector. This output will also be amplified. As the input frequency changes, so will the output frequency—but output amplitude will remain constant at the peak supply voltage so long as enough input signal is supplied. Presto, you have a four-component FM limiter!

If you need a source of square waves, the transistor switch will provide them. Simply feed in a sine wave of the proper frequency, strong enough to drive the switch completely into saturation on each half-cycle, and pick off your square wave at the collector. In both of these "example" circuits, of course, a resistor is used for the switch load, as shown in Fig. 2.

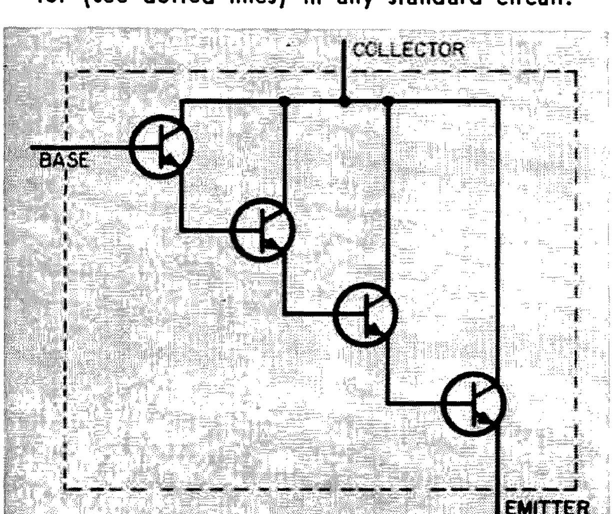
Another transistor-only circuit can be used to obtain any gain you might desire in a single stage—up to a limit of some 250,000,000 times! Known variously as the Darlington and the compound connection, it combines two or more transistors into a single "compound transistor" which has a gain equal to the product of all the gains of each transistor involved.

The connection is shown in Fig. 3. Once the transistors have been connected together, think of them as a single unit with only three leads—base, emitter, and collector—and an overall gain equal to the product of the individual gains.

For an example, consider four type 2N508 transistors (an audio type selling for approximately $2.00 which is unequalled gain-wise by anything else near that price), each of which has a current gain (or *beta*) of 125. When all four are connected in compound, the total gain is 125^4 or approximately 250,000,000—all in a single stage.

The practical limit to gain obtained in this manner is input noise. When leakage current from the first transistor in the compound becomes great enough to mask out the desired signal, you have too much gain. Remove one transistor and try it for size a second time.

Fig. 3—The compound conection shown here provides a unit with gain ranging up to 250 million times. Though four transistors are shown, there is no theoretical limit to the number which may be used. Current gain of the total unit will be the product of each individual transistor's current gain. The individual transistors may be identical or of different characteristics, so long as all are either PNP or NPN. The compound unit is used as a single transistor (see dotted lines) in any standard circuit.



Use of circuits such as these can freqently simplify a design when it is converted from tubes to transistors. A case in point is Jim Kyle's "Five-Dollar Frequency Meter."

The original tube-style frequency meter circuit used four vacuum tubes—two were in a squaring amplifier, one double-diode was in a counter circuit, and the fourth was the power-supply rectifier.

An earlier adaptation of that circuit to transistorized form used two transistors and four diodes to accomplish the same purpose. Two of the diodes squared the input signal, the transistors amplified it, and the other two diodes formed the frequency counter.

However, application of the basic switching circuit not once but twice brought the total unit down to two transistors. The input switching transistor converted the input signal to an amplified square wave, while the second transistor's base served as both counting diodes and its collector provided DC amplification, enabling use of a less expensive meter for indicating purposes.

You can do the same with your favorite tube circuit—if you just remember that straight substitution isn't the answer. Usually, if you take the time to figure out the differences, the fully-transistorized circuit proves simpler in the end. 73

Simplify Your Log-Keeping

Any active ham knows that keeping his log accurate is simple—but checking back to verify a contact six months later can prove to be a nightmare. Here's a log-keeping trick (checked out and approved by the FCC) which can simplify QSL problems and bring order out of chaos.

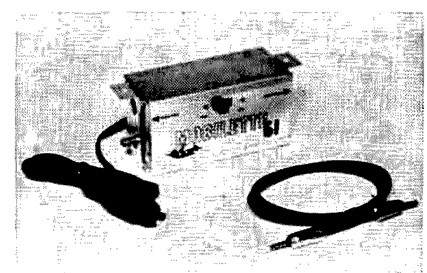
Simply keep the log on 3x5 filing cards, one card per contact, rather than in the conventional log-book. Suitable cards are available commercially, already printed with blanks for the pertinent information, or you can make your own. Be sure to include the calls of both stations, the time and date of the contact, the frequency, and your power input, if you prepare your own. A separate card can be used for TEST and CQ operating time.

Once filled out, the card is filed—not chronologically—but in alphabetical-numerical order. That is, DL4 cards would be filed ahead of DL5, and both would be ahead of K1's.

With this filing system, every contact can be quickly verified, given the call of the other station. All required information is still kept, and QSL bookkeeping becomes a pleasure rather than a chore. Try it and see! 73

New Product

Mobile Converters



International Crystal Mfg. Co. has a new line of mobile converters that may be just what you're looking for. These gadgets are quite small for simple mounting under the dashboard and operate either from 6 or 12 vdc, negative or positive ground. They are transistorized, have a peaking control, separate inputs for short-wave and broadcast antennas, and a switch which permits normal BC operation when not in use. The output range is 600-1600 kc and models are available for converting from all ham bands, from 75 thru 6 meters, the 27 mc citizens band, low band CAP, and the 10 or 15 mc WWV broadcasts. These sell for $22.95 each. Special models will be made for any band in the 2-50 mc range for $25.95. Buy a bagfull. The 40 meter model pulls in the CHU time signals as well as letting your eavesdrop on 40 meter doings.

Book Review

Three books were received the other day for review in **73.** All three have to do with radio service, which seems rather off the track for a ham magazine. For what little help it will be to them here they are:

1) **Practical TV Trouble-Shooting**, Gernsback Library #102. This 128 page paperbound book is a collection of reprints from Radio Electronics magazine and explains how to fix some of the "problem" sets a TV serviceman runs up against. $2.35.

2) **Practical Auto Radio Service and Installation**, Gernsback Library #87. This one is 160 pages and costs $2.95. The chapter on interference suppression may be worth the price of the book if you're having trouble with this misery.

3) **Radio, Television and Electrical Repairs**, Odhams Press. This British book (third edition) is chock full of pages (480 of them) tells you how to repair radios, record players, FM sets, vacuum cleaners, electric water heaters, refrigerators, washing machines, cookers, hot plates, and almost anything else you can think of. The British illustrations are fascinating. 21s, which about $3.00 over here . . . plus shipping and all that.

Tape Recorder Book

Rider (#251) has just published a new tape recorder book called "Getting The Most Out Of Your Tape Recorder." This 176 page soft cover book approaches the subject from the user viewpoint and will not strain the technical understanding of the Novice. It is profusely illustrated, as is usual with the Rider books. To give you an idea of the field covered, here are some of the chapters: What Kind of Tape Machine Do You Need?, How Many Heads Do You Need?, Types of Record Level Indicators, Adding a Tape Recorder to the Audio System, Microphones, Tape Accessories, Varieties of Tape, Frequency Response, Distortion, Signal to Noise Ratio, Equalization, Checking Frequency Response-Equalization - Azimuth - Head Height - Bias - Distortion - Noise, Stereo Considerations. Price is $4.25.

The Perfect Squelch

Staff

Especially in mobile or VHF operation, the background noise emitted by a receiver when no signal is coming in can become tiring in a hurry. Fortunately, it's not difficult to squelch out this noise with a muting circuit.

Such circuits are popular. This popularity is attested to by the number of different articles published on them in the last five years. The only trouble is this: with so many different circuits in print, how are you going to choose the one which best suits your needs . . . the perfect squelch?

To help you make this decision, we've gathered these circuits all in one place. Advantages and disadvantages of each are listed to help you choose which one will work best for your own installation.

Before going into details of the various squelch circuits, let's take a look at the basic purpose of such a system and the various ways in which this purpose may be accomplished.

The purpose is simple—to quiet audio output from a receiver when no signal is coming in. The ways of doing this, however, are legion . . . and each has its own set of pros and cons.

You can open the audio path with a carrier-controlled switch (the basic operation of most squelch circuits) or you can short-circuit this same audio path with a similar switch acting in reverse. You can use another carrier-operated switch to turn the whole receiver on or off—but this requires, in essence, two receivers, and so is not very practical in use.

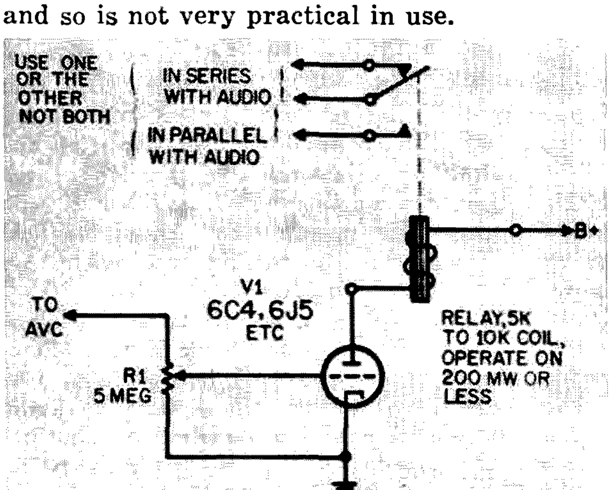


Fig. 1—Schematic Diagram of Relay-Squelch Circuit.

Another approach is to use part of the audio signal itself to control a switching circuit. Squelches based on this principle are usable for sideband or CW as well as AM and FM. Any muting device which depends on the carrier for operation won't work so well with carrierless sideband.

You can see that all these techniques require some sort of switching circuit. However, this switch may be either a relay, a biased diode, a multi-grid vacuum tube, a combination of triodes, a transistor, or any other electronic device which allows one signal to control passage of another.

By the mathematical laws of permutation and combination, and considering only the items specifically listed above, this works out to a total of 20 possible different circuits. When you take into account differences in equipment, the number of possible practical circuits runs rapidly into the thousands.

We aren't going to talk about any thousand circuits here. We aren't even going to talk about 20 of them, since some of the possible combinations don't work out in practice. We *are* going to talk about all the practical squelch circuits which have appeared in the literature since 1945.

These circuits fall into six broad categories. The best-known of these is possibly the relay-squelch circuit, made famous by the SCR-522 and since adapted to many other receivers.

Other categories include shunt-tube squelch,

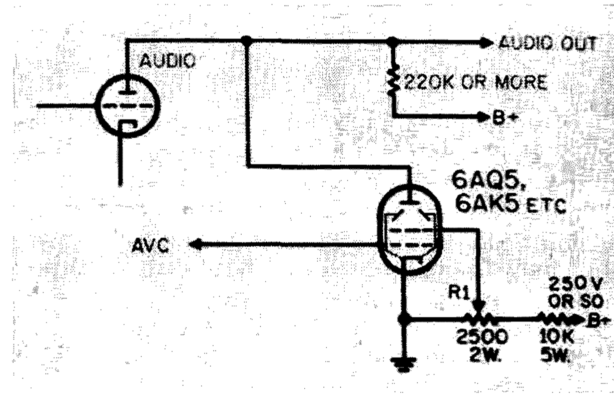


Fig. 2—Schematic Diagram of Shunt-Tube Squelch.

biased-detector muting, balanced-modulator quieting (the best example of which is the famed TNS), noise-operated circuits, and audio-cutoff (the basis of Western Electric's family of CODANs).

Since the relay-operated circuit is one of the best known, let's look at it first (Fig. 1). Component values shown on the schematic are all non-critical; almost any combination of junk-box parts should work well. The only requirement is that the relay operate when AVC voltage increases.

In operation, when no signal is tuned in the AVC level is at a minimum. The squelch tube (V1) draws plate current, holding the relay actuated. With arrival of a signal, AVC voltage rises. This voltage cuts V1 off, allowing the relay to drop out. The portion of AVC applied to the grid of V1 is selected by R1, the squelch-level control, allowing the operator to select the operating point of muting.

Contacts of the squelch relay can be connected to short an audio tube's grid to ground, or to open the speaker leads, as desired. Shorting the grid to ground usually results in quieter operation, but care must be taken to be sure you don't remove the tube's protective bias when you short it out.

Advantages of the relay squelch include ease of construction, inexpensiveness (when you have a well-stocked junkbox), and sureness of operation.

Disadvantages include the mechanical "plop" of the relay every time it operates, and the loading of the AVC line by R1. R1 will reduce the AVC time constant enough to prevent use of "hanging" AVC action on sideband signals. In addition, if you must purchase the relay and can't find a suitable surplus unit, it will probably cost close to $10 to build.

One of the least-known squelch circuits is the shunt-tube arrangement shown in Fig. 2. Like most other muting devices, it depends on AVC voltage for control — but unlike most other circuits, it requires almost no alteration of the receiver's existing circuitry. The only change necessary is substitution of a 220K ohm resistor in the first audio plate circuit if the existing resistor has a lesser value.

In operation, the squelch tube draws plate current if AVC is not present. By proper choice of tube—a 6AK5 or 6AQ5 is ideal—this drain may be made so heavy that voltage at the first-audio-tube plate drops nearly to zero. With almost no plate voltage, gain of the audio tube drops to nothing and the receiver is quiet.

When AVC arrives at the grid of the control tube, its plate current is reduced and voltage at the audio-tube plate rises because of less drop through the 220K resistor. When AVC is high enough—the amount of AVC necessary is determined by the control-tube screen voltage, set by R1—the control tube is cut off and the audio tube receives full plate voltage. Signals then pass through the audio stage.

Advantages of this circuit include the limited amount of receiver rework necessary and the low cost of parts.

Disadvantages include the necessity of providing filament power for another tube, and limited control of the squelching point (with a sharp-cutoff control tube, any AVC greater than about 5 volts will open the squelch regardless of control setting).

Biased-detector muting, one of the simpler

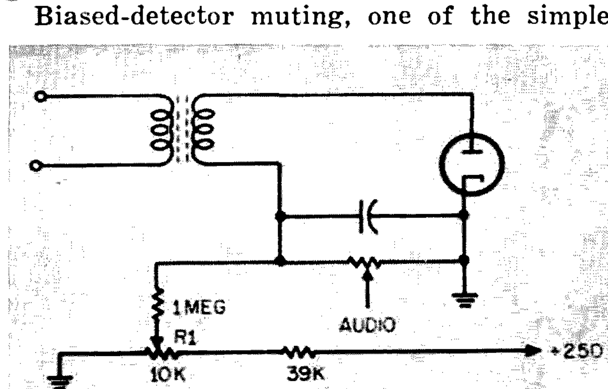


Fig. 3—Basic Biased-Diode Muting Circuit, Schematic Diagram.

squelch circuits, has probably been the subject of more articles than any other individual circuit type. The basic circuit is shown in Fig. 3, and a more-sophisticated version which overcomes the greatest disadvantage of the basic circuit appears in Fig. 4.

The principle of operation of this circuit depends on diode switching. Whenever the plate of a diode is negative in respect to the cathode, the diode can't conduct. On the other hand, if the plate is positive the diode conducts and looks like a short circuit so far as any other applied signal is concerned.

By applying a positive voltage to the detector plate, the detector is effectively shorted and no audio (noise) can be fed to the receiver output. An incoming signal will also be shorted, until its amplitude is great enough to overcome the detector bias and drive the plate negative on peaks.

At that point, normal detector action resumes and the signal is heard. Adjustment of this critical bias point is made simply by varying the voltage applied to the detector plate with R1.

The basic circuit has only three added parts and requires only two connections to the receiver (aside from a grounding point). Cost is less than a dollar. Other advantages include an automatic delayed-AVC result (since the detector must overcome the squelch bias to develop AVC as well as audio) and a total lack of complicated adjustments.

However, the biased-diode basic circuit has a major disadvantage — distortion. Signals which are extremely strong compared to the noise will be relatively unaffected, but consider the case of a signal barely above the noise threshold. Only the peaks of the signal will open the squelch, and the resulting output signal will bear little resemblance to the original. In fact, it will be unreadable.

To overcome this disadvantage, the more-sophisticated biased-diode detector shown in Figure 4 was developed. It is adapted from a circuit described in 1943 by K. R. Sturley.

In operation, with no input signal, tubes V2 and V4 are conducting. The cathodes of V3, V4, and V5 are all positive, and since V2's plate is positive and it is conducting, its cathode will also be positive to ground.

With V2's cathode positive, the cathode of V1 will be positive also, and the detector will be unable to operate for exactly the same reason as in the basic circuit. AVC voltage will be zero, as will audio output.

When a signal comes in, it is coupled through the capacitors to the plate of V3. V3, acting as a shunt detector rather than the conventional series type, rectifies the signal to produce a negative voltage at the top of the 25K load resistor. This voltage goes through the 470K isolation resistor to the grid of V4, increasing the tube's resistance and lowering the positive voltage on the cathode bus.

At a level determined by the setting of level control R1, the positive voltage on the cathode bus is cancelled by the fixed negative bias voltage. At any signal level greater than this, the negative bias overrides and changes the polarity of the cathode bus. At this time, V5 conducts and allows AVC voltage to pass. At the same time, V2 is cut off. With V2 cut off, the positive voltage is removed from the cathode of V1 and the detector resumes normal operation.

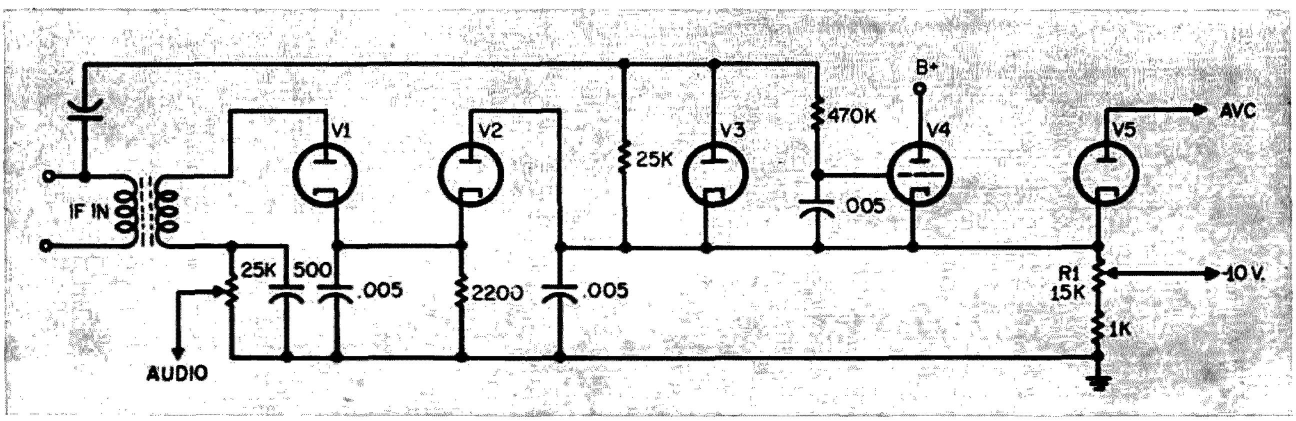
The distortion inherent in the basic circuit is overcome in this circuit by proper choice of RC time constants. Before all switching elements operate and allow the signal to pass, the signal must be far enough above the squelch level to be out of the distortion zone.

The relative freedom from distortion is the only advantage the circuit of Fig. 4 has over other squelches. Obvious disadvantages are the circuit complexity and the necessity for complete rebuilding of the audio detector-AVC portion of the receiver.

The balanced-modulator squelch used in the TNS circuit is shown in Fig. 5 in simplified form. For a detailed construction-type schematic of the TNS, see the references.

In operation, with no incoming signal, neither V1 nor V2 has any grid bias. Cathode bias provided by identical resistors keeps plate current within safe limits. Squelch control R1

Fig. 4—Advanced Biased-Diode Muting Circuit, Schematic Diagram.



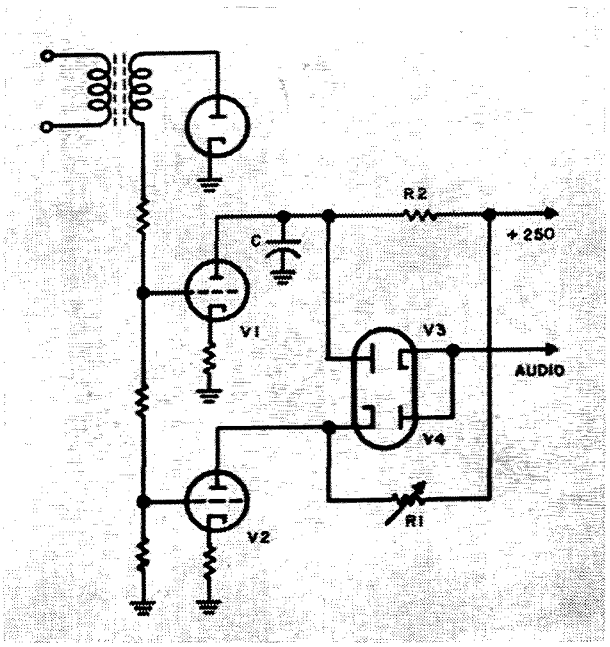


Fig. 5—Balanced-Modulator (TNS) Squelch, Simplified Schematic Diagram.

is set so that the voltage at the plate of V2 is slightly more than the voltage at the plate of V1.

Since the plates of both V1 and V2 are direct-coupled to diodes V3 and V4, this setting of the squelch control makes the cathodes of both diodes positive with respect to their plates. With the diodes not in conduction, no audio signal passes through.

With a signal coming in, the picture changes. The input voltage divider (which replaces the normal detector load resistor) is designed so that V1 receives half the AVC voltage as grid bias, while V2 gets only one-tenth.

This drives the plate of V1 positive as compared to the plate of V2, and biases V3 and V4 into conduction. Audio goes through.

Capacitor C, in conjunction with R2, perform the noise clipping. See Bill Orr's "Mobile Handbook" for a complete explanation of the TNS circuit—we're only concerned with its squelching action here.

Least-publicized of all squelch circuits, in ham literature at least, are those operated by noise. Most commercial two-way mobile gear uses this type of squelch.

The distinguishing feature about the noise-operated squelch is the origin of its control signal. While other muting circuits depend primarily on AVC developed by an incoming carrier, the noise-operated version picks up AF noise from the detector, amplifies it, rectifies it ,and uses the resulting DC as a control signal.

This works because most receivers exhibit a degree of "quieting" of background hiss with an incoming signal. With some high-quality VHF receivers, incoming signals produce an increase in background noise—and with these sets, a noise-operated squelch won't work.

Workings of the noise-operated muting circuits are explained in block-diagram form in Figure 6. A practical schematic, derived from the RCA Carfone series of commercial two-way sets, is shown in Fig. 7.

Looking at the two illustrations together, C1 and the 10-mh rf choke together comprise a 10-kc resonant circuit. This resonant circuit is the "high-pass filter" of the block diagram, picking off noise components of the detector output and feeding them to the triode section

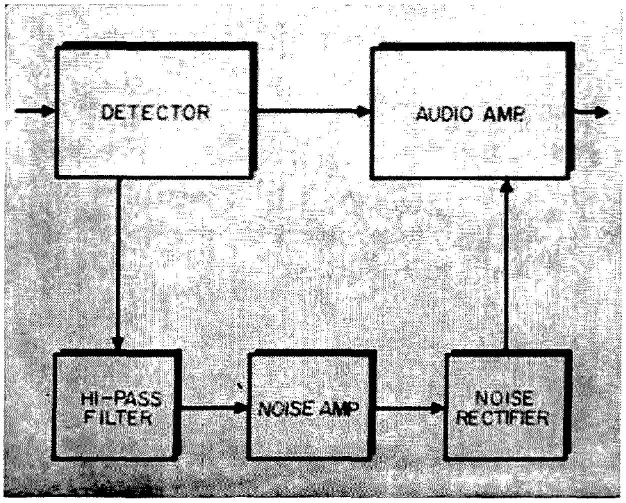


Fig. 6 — Noise - Operated Squelch, Block Diagram.

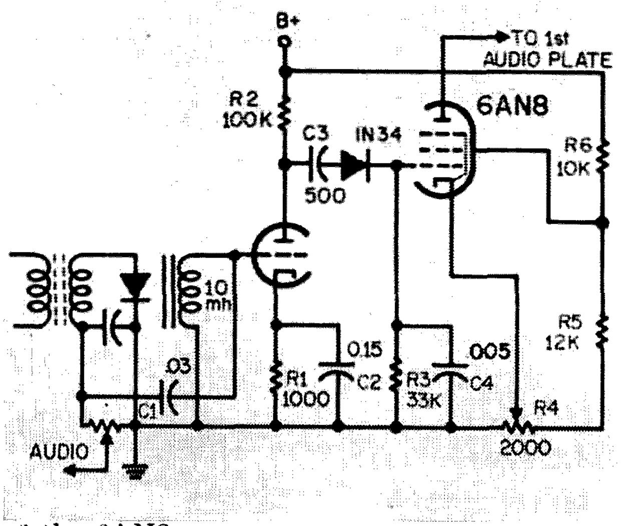


Fig. 7—Noise-Operated Squelch, Schematic Diagram.

of the 6AN8.

The noise is amplified in this stage, which includes bypass (C2) and coupling (C3) capacitors tailored to pass only high-frequency signals and to block voice-frequency output. The 1N34 rectifies this amplified noise voltage to produce a positive voltage at the top of R3, which is coupled directly to the 6AN8 pentode control grid.

This positive voltage on the grid doesn't hurt the tube, since a similar positive voltage is also applied to the cathode through R4, the squelch control (which may be remotely mounted since it carries only dc), and the voltage divider, R5 and R6.

The pentode half of the 6AN8 is the audio-control tube, operating in the same fashion as the shunt-tube squelch discussed earlier in this article.

In the absence of signal, noise is picked off and amplified. It reaches the grid of the 6AN8 pentode as previously explained. Cathode voltage on the 6AN8 will have been adjusted, via the control, to be slightly less than that on the grid. As a result, the tube conducts heavily, dropping plate voltage of the audio tube to less than a volt and cutting off all sound from the set.

When a signal appears, the noise level diminishes. This causes the voltage at the output of the noise rectifier to decrease, leaving the 6AN8 pentode's control grid less positive than its cathode. The tube is cut off, plate voltage to the audio stage rises to the design value, and the set functions normally.

Advantages of this circuit which make it particularly attractive to the commercial manufacturers include its relative indifference to incoming signal strength. So long as the signal is above the noise level, it will operate the squelch—something not possible with any AVC-operated squelch. It also removes the squelch control from both high-voltage and signal-carrying circuits, allowing remote placement with no difficulty.

Disadvantages, naturally, include complexity and expense. While the entire circuit can be put together on a Vector turret socket and mounted in a small Minibox, it's still one of the most complicated of the six basic squelch circuits. With so many parts, it's more liable to failure due to the inherent perversity of inanimate objects. And troubleshooting this squelch circuit can drive the most patient technician mad, since any symptom can be caused by any component.

This brings us, naturally, to the audio-cutoff muting circuit. Developed for transoceanic telephone circuits by the Western Electric Company, it falls between the shunt-tube cir-

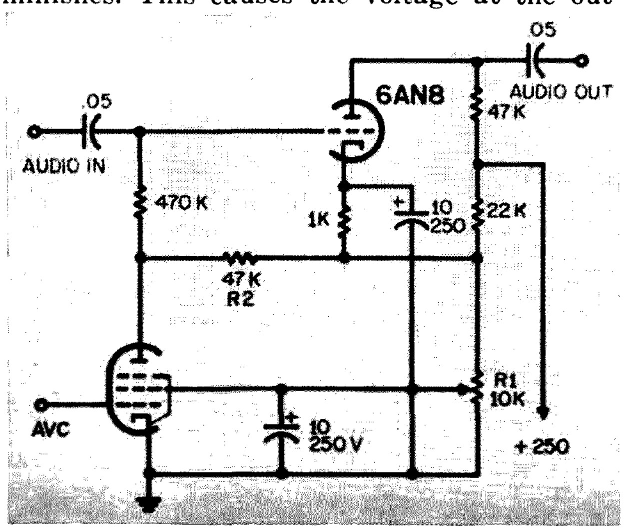
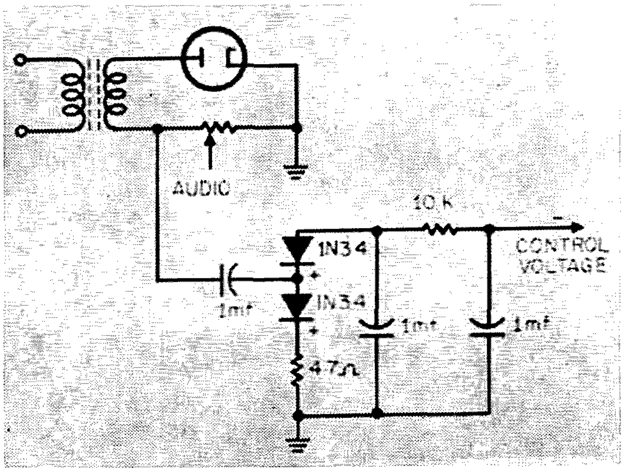


Fig. 8—Audio-Cutoff Squelch (CODAN), Schematic Diagram.

Fig. 9—Audio-Derived Control Voltage Adapter for Any Squelch Circuit, Schematic Diagram.



cuit and the noise-operated genre in complexity. A diagram appears in Fig. 8.

This circuit, like most others, is operated by AVC voltage. However, unlike some others it does not offer any load to the AVC bus.

In the absence of AVC, the pentode section of the 6AN8 conducts heavily. Just how heavily is determined by the setting of squelch control R1, which adjusts screen voltage and also determines the amount of negative voltage required to cut the tube off.

Plate current of the pentode section must pass through R2, which is also in the grid-cathode circuit of the triode section. The resulting voltage drop across this resistor is applied to the triode as negative grid bias, cutting the tube off and killing audio output.

When AVC is applied to the pentode, it is cut off and no plate current flows through R2. With no voltage drop, the audio tube functions normally.

Advantages of this circuit include a wider range of control in the squelching level (the CODAN can be set to operate for S7 signals but to reject those which are S6 or below) and additional audio gain, compared to other squelch circuits.

Disadvantages are its complexity as compared to shunt-tube, relay, or biased-diode muting circuits; the relatively high voltage applied to the squelch control; and the sensitivity to hum directly due to added audio gain. All parts of this circuit must be shielded, and especial care must be taken to keep the heater leads away from the audio signal path.

That completes the six basic squelch circuits —but there's still one more thing worth mentioning.

In all except the noise-operated circuit, the AVC line furnished the control signal which triggered the squelching switch. This works fine on AM or FM, but if your receiver is not equipped to use AVC on CW and sideband you won't be able to enjoy the advantages of squelch with these modes of communication.

A simple way to lick this difficulty is shown in Fig. 9. By picking audio voltage off the detector output at the top of the volume control, rectifying it in a voltage doubler, and using the negative output as control for the squelch, dependence on the AVC line is eliminated. Any audio developed at the detector will actuate the squelch, allowing it to be used with all communication modes. 73

References

Relay-Squelch Circuits:

F. W. Muilings, W5BVF, *Squelch for any FM or AM receiver,* CQ Magazine, April, 1957, page 77.

Sol Leise, W3LJV, *Squelch for the NC-300,* QST, March, 1958, page 31.

D. L. Steinbach, W7FLC, *A Squelch—That Works!,* CQ, May, 1959, page 56.

Shunt-Tube Circuits:

James Lanterman, K4GOM, *Real Easy Squelch,* CQ, April, 1958, page 33.

Biased-Diode Circuits:

F. Langford-Smith, *Radiotron Designer's Handbook,* fourth edition, pages 1125 and 1126.

K. R. Sturley, *Radio Receiver Design,* Chapman and Hall, London, 1943, Part 2, Chapter 12.

H. Lukoff, W3HFT, *Squelch for 92¢,* CQ, June, 1958, page 51.

Bruce L. Mackey, *Squelch Circuit for Hallicrafters S-85,* QST, December, 1958, Hints and Kinks, page 69.

D. N. Shrader, K3CCC, *Squelch for Hallicrafters SX-99,* QST, May, 1959, Hints and Kinks, page 50.

Balanced-Modulator (TNS) (partial listing only):

W. I. Orr, W6SAI, *Mobile Handbook,* pp. 85-91.

W. I. Orr, W6SAI, *Radio Handbook,* 15th Edition, page 230.

Noise-Operated Squelch:

Bob Eldridge, *2-Way Mobile Squelch Problems,* Radio & Television News, February, 1959, page 72.

Audio-Cutoff Circuit:

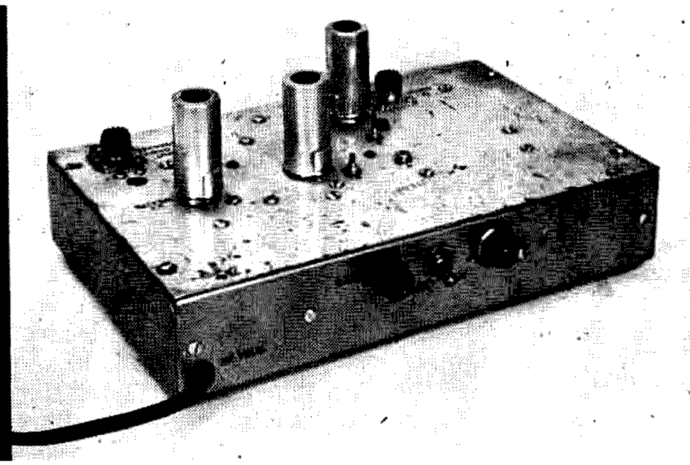
American Radio Relay League, *The Radio Amateur's Handbook.*

Langford-Smith, *op cit,* page 1127.

F. E. Terman, *Electronic and Radio Engineering,* fourth edition.

IN 1957 two radio amateurs, John Chambers (W6NLZ) and Ralph Thomas (KH6UK), astounded the scientific world by doing the impossible. They communicated with each other over the 2500 mile path between Southern California and Hawaii on 144 mc, a line-of-sight band! Only a short decade ago, radio textbooks described this frequency as having very limited range, and actually gave a formula for computing distance. The answer was usually 25 miles, or so!

A Low Noise



You can be assured John and Ralph did not accomplish this tremendous feat using super-regen receiver or even superhets with a simple 6BQ7 cascode rf amplifier. The received signals were a small fraction of a millionth-volt (microvolt). At this level the rf amplifier stage, the antenna, and even the cosmos, gang up on the signal and try to push its head under a sea of noise. This noise is the hiss you hear on a television receiver between channels, and is the mating call of electrons in motion.

You can't do much about cosmic noise, or the antenna for that matter, but you can construct an rf amplifier which will contribute as little noise to the signal as possible. This converter incorporates such an rf amplifier. Its impressive performance is indicated by the signals received when it was tuned to the satellite frequency of 108 mc. Excellent recordings were made of the 10 milliwatt "Vanguard" transmissions when it was at the zenith of its orbit, some 23,000 miles away! Although no spectacular dx has been received on two meters, due to a poor location, the receiver noise increases considerably when the 10 element beam is turned toward the sun[1, 2].

Theory of Operation

The purpose of this type of converter is to *translate* signals from the transmitted frequency down to a more convenient range. Most amateurs possess a communications receiver covering 1.5 to 30.0 mc, but few have the time or inclination to construct a receiver for 2 meters. By building this low-noise converter, they can have a first class receiver with only a few hours work.

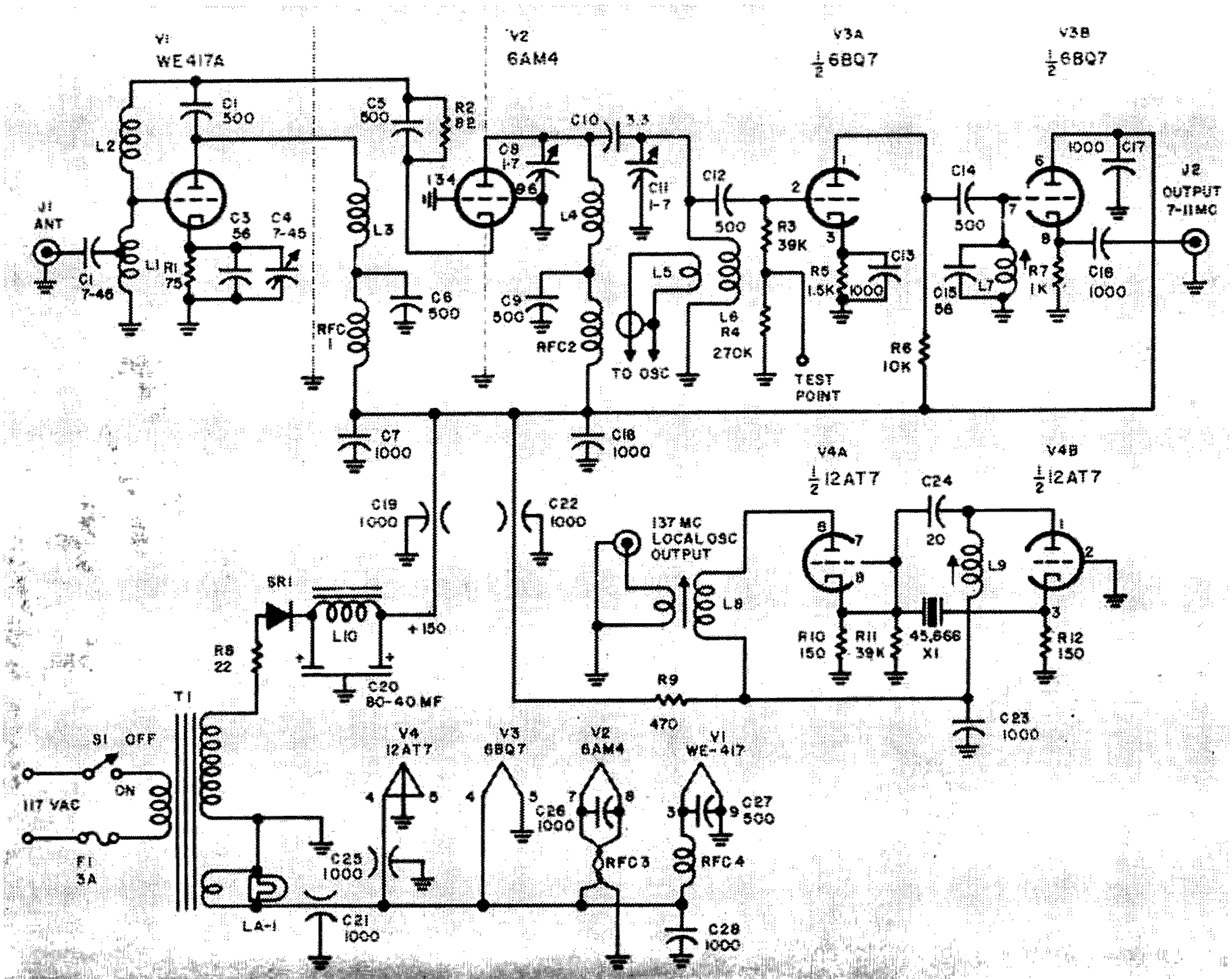
Fig. 1 is the schematic diagram of the low-noise converter. The antenna, connected to J1, is coupled to the rf amplifier grid coil (L1) through a 7-45 mmfd trimmer. This capacitor brings about an impedance match between the transmission line and tuned circuit and avoids experimenting with various tap points on L1.

The rf amplifier circuit is an offshoot of the common 6BQ7 cascode circuit found in most television tuners. However, this circuit, which was designed by W2AZL[3], has many innovations which combine to provide an extremely low noise figure (a figure of merit which determines how weak a signal can be detected). A 6BQ7 in a television tuner might have a noise figure of 7 or 8 db, when set to channel 13, since the response must be at least 6 mc wide. If the same tube and circuit was peaked on a small portion of the 2 meter band, the noise figure might drop to 5.5 db. Replacing the 6BQ7 with a lower noise tube (such as the 6AJ4 or 6AM4) would knock off another

Two Meter Converter

Lester Earnshaw ZL1AAX
Box 51
Warkworth, New Zealand

Fig. 1—Schematic diagram for the low noise two-meter converter.



db. This circuit, incorporating a Western Electric WE417A, is capable of a noise figure which is less than 3 db! The value of reducing the noise figure below this point (with parametric amplifiers, masers, etc.) is subject to considerable debate since cosmic noise usually masks weak signals anyway.

The rf amplifier, V1, varies from the usual cascode configuration in that the anode circuit is resonated (L3) and capacitively coupled to the 2nd rf amplifier. This also permits a lower power supply voltage to be used. Ordinarily this circuit would oscillate due to the grid-plate capacity in V1. However, the addition of a neutralizing coil (L2) feeds back a small amount of out-of-phase energy to cancel the effects of tube capacity. Another "trick" which really soups up the rf amplifier is in the cathode circuit of V1, the use of a resonating capacitor (C4). Tilton has shown[4] that series resonating the cathode inductance truly "grounds" the cathode and minimizes if degeneration. Resistor R1 biases the tube and prevents excessive plate current.

A second rf amplifier, which completes the cascode pair, is a 6AM4. Earlier it was pointed out that this tube is somewhat "noisier" than the WE417A. However, this stage has very little effect on the noise figure and there is no advantage in using another WE417 for V2. Self bias is provided by R2 and the plate is resonant at 2 meters (L4 and C8).

The highly amplified signal is coupled to the mixer (V3a, a 6BQ7) where it combines with the oscillator energy that is link coupled to L6. A beat difference between the signals (the intermediate frequency) appears across R2 and is coupled to the cathode follower V3b. This stage has no amplification but simply provides an impedance match between the if coil (L7) and the receiver.

The Oscillator

The oscillator is a modified Butler circuit with feedback between the two low impedance cathodes. The crystal is a third overtone type and oscillates at 45.666 mc. Coil L9 is also resonant at this frequency and the energy is coupled to V4a, which triples to 137 mc. A small amount of 45 mc energy appears at the cathode of V4a (pin 8) and this rf is coupled back to the oscillator through the crystal to sustain oscillations. The local oscillator signal

Underside view of the converter showing the location of the compartments and shields. The layout in the rf amplifier section should be followed closely.

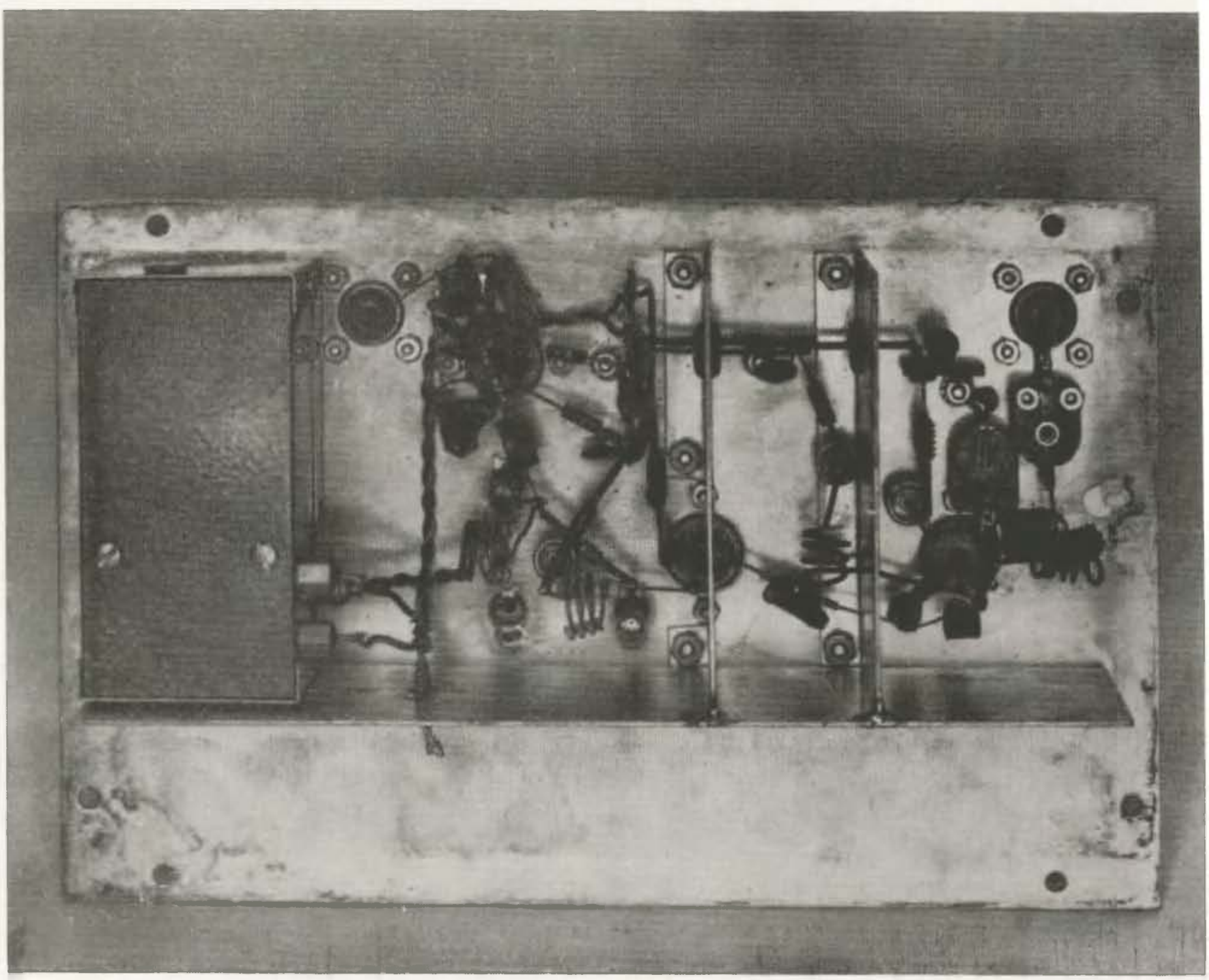


Fig. 2—Crystal and intermediate frequency chart. Note that the local oscillator injection frequency is always three times the crystal frequency and is below the signal frequency by the if.

CRYSTAL FREQUENCY	X3	PLUS IF = 144-148 mc
45.667 mc	137.0 mc	7-11 mc
43.333 mc	130.0 mc	14-18 mc
39.333 mc	118.0 mc	26-30 mc
39.000 mc	117.0 mc	27-31 mc
38.833 mc	113.5 mc	30.5-34.5 mc

(137 mc) is coupled to the mixer from L8 to L6 through a short length of twisted hookup wire. The oscillator circuit is characterized by extremely stable operation. It either oscillates or it doesn't! There are no "half-way" oscillations where the crystal jumps frequency or pops from one mode to another. The frequency drift is also truly remarkable for such high frequency operation. The drift from a "cold start" is only a few hundred cycles. This is quite important when signals arrive intermittently due to temperature inversions. It is nice to know exactly where a station will appear when the band opens up.

The power supply is the most conventional part of the converter. It consists of a simple half-wave rectifier-filter system. An 80-40 mfd electrolytic and 5 hy filter choke provide near pure dc to the plates. An rf filter is included in the filament circuit of the WE417 to prevent undesired regeneration. A bifilar wound choke is used in the filament circuit of V2 since its cathode is at rf potential. Feedthrough capacitors (1000 mmfd) are used to feed filament voltage and B+ into the rf section and oscillator compartment. This complete shielding prevents reception of any spurious signals such as might occur if the 45.666 mc energy leaked out of the oscillator compartment. No if signals can force their way through the power supply either.

Choosing an IF

The choice of an if is not a haphazard thing. If the if is too low, images will become a problem. On the other hand, if it is too high, receiver stability may be the problem. In general, 7 to 11 mc, and 14 to 18 mc, are favored. The 14 to 18 mc range may be preferred for simply by inserting a "4" between the numbers, you can read the signal frequency (144- 148 mc) directly from the receiver dial.

Fig. 2 shows some of the common if's and how they are figured. Note that the local oscillator is always lower than the signal frequency by the amount of the if and the crystal is always one-third of the oscillator output. From this information you can easily determine a crystal frequency for any desired if. The 26- 30 mc range would be used by owners of Collins receivers which cover one and two mc bands. The 27- 31 and 30.5 - 34.5 range is useful for communications receivers which have a special calibrated scale for the two meter band.

If the 14- 18 mc range is selected, rather than 7- 11 mc, capacitor C15 should be removed. If any of the other ranges are used, delete C15 and use only 20 turns on coil L7. The only other coils affected, in the oscillator compartment, will cover the full range and need not be modified.

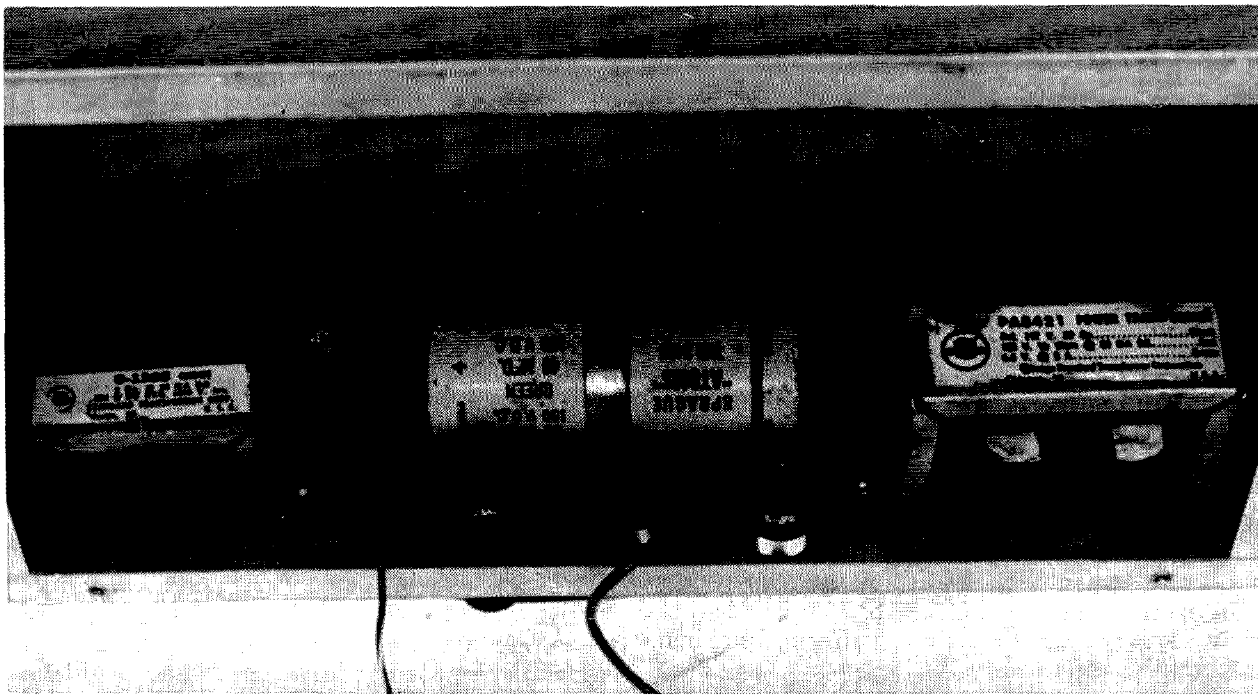
Shielding

One of the success secrets of this converter is the careful use of shielding. When the circuits are isolated from each other by shields, each stage can have more gain without excessive regeneration.

A long shield bracket runs the length of the chassis to prevent stray signals in the power supply from coupling over to the rf circuits. Another shield is placed between V1 and V2. This shield also prevents coil L3 from "seeing" the input coil L1. The hot lead of L3 and the wire from C5 and R2 passes through holes in the shield. At the opposite end, the filament wire passes through a grommet in the shield. No feedthrough capacitor is required since this wire, and the B+ lead, is "stone cold".

Another shield passes through the center of the 6AM4 socket. The center post of this socket, along with pins 1, 3, 4, 6, and 9 are bent over and soldered to the shield. The remainder of the signal circuits are relatively uncritical and no shields are required. Note that all tubes are shielded except V4.

By way of contrast, the oscillator is really "buttoned up". Originally the oscillator was mounted on the chassis and capacitively coupled to the mixer. When the converter was tested, a 60 cycle buzz was heard near each end of the range (7- 11 mc). After many late hours watching the "modulated milk bottle", it was determined that these spurious signals were the picture carriers of channel 2 and 5. A little exploration with a high frequency receiver showed that the extremely strong television signals were bullying their way through the tuned circuits. In the mixer, the spurious signals were able to combine with a small amount of 45 mc (and 90 mc second harmonic) energy to produce a beat in the if range. Rewiring the oscillator and bottling it up in a box turned the trick. Even though the television signal may still force its way to the mixer, all it runs into is 137 mc. Thus any beats created are well outside the if.



The converter power supply is built into the chassis base.

Layout

Other than the details just given, there are no particular precautions regarding layout. You may want to incorporate some ideas of your own and therefore no detailed layout drawing is included. However, a few basic facts are in order.

The converter is built on a 7" X 11" plate which is mounted on the 7" X 11" X 2" aluminum chassis. The chassis serves to enclose the rf circuits in addition to providing a foundation for the power supply. Although it may be "guilding the lily", the chassis and all shield plates were silver plated.

Some constructors may wish to include the power supply on the plate rather than the chassis. This would make the construction somewhat easier and should not create any particular problems other than layout of components.

In the 1st rf compartment (V1) you will find C1, C2, C3, C4, C27, and C28, coils L1, L2, and RFC 4, along with resistor R1. In between shield plates the following components are located: L3, RFC 1, C5, C6, C7, and R1. Note that C6, C9, and C27 are button standoff capacitors and serve as tie points for the associated components. Coil L4 is supported by its leads between C8 and C9. One end of L6 is soldered to the chassis and the other end is supported by the terminal on C11. The test point jack serves as a tie point for R3 and R4. Resistors R6, R7, and capacitor C17 are located between the tube socket and the adjacent terminal strip.

The oscillator circuitry is contained in a 2¼" X 2¼" X 4" chassis box and includes the following components; C22, C23, C24, L8, L9, R9, R10, R11, R12, crystal X1 and socket, and the tube. No terminal strips are required.

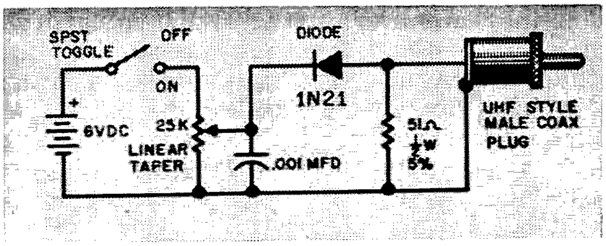
When wiring the converter be sure to keep the leads as short as possible, particularly around the rf amplifier. The same is true for the coils. Other than the slug-adjusted coils, they should be self-supporting with short leads. Two lug terminal strips are used in the rf compartments, and a five lug strip between the 2nd rf and mixer stages provides a tie point for the filament and B+ circuits in that area.

Alignment

If you do a good job of wiring the converter, and are lucky with the setting of the local oscillator coils, the converter will probably work without any tuning whatsoever. However, don't expect to obtain a noise figure less than 3 db without a certain amount of "fiddling". You should be able to obtain a noise figure around 5 db with an "ear alignment". To tune the converter for minimum noise you will need a noise generator to adjust the rf amplifier[5].

Start the alignment by setting the oscillator coils to approximately 45 mc (L9) and 137 mc (L8). Have all circuits energized to load the power supply. The oscillator compartment should hang by its leads and be grounded to the chassis with a short wire. With a grid dip meter, preset the coils to their correct resonant frequency. Then turn the dip meter plate switch off (making an absorption wavemeter out of it) and adjust L9 for an indication of rf. Turn the power supply on and off a few

Fig. 3—Schematic diagram for a simple noise generator, useful in adjusting the low noise converter. The potentiometer is set so the noise approximately doubles when the switch is turned on. Then simply turn the generator on and off and adjust the converter turned circuits for the greatest increase in noise when the generator is switched on.



times to make sure the oscillator starts easily. Next move the dipper to the link (external to the box) and adjust both coils (L8 and L9) for maximum rf consistent with stable operation.

Now, install the oscillator box on the chassis plate and tightly couple the link to L6. If you like, you can again set the oscillator coils by adjusting them for maximum voltage at the test point jack. It is likely that enclosing the coils (by covering the box) may detune them slightly. Connect the converter to a receiver and 2 meter antenna. Peak coil L7 for maximum "hiss" at the center of the band. Then adjust C8 for maximum at the low end and the same for C11 at the high end.

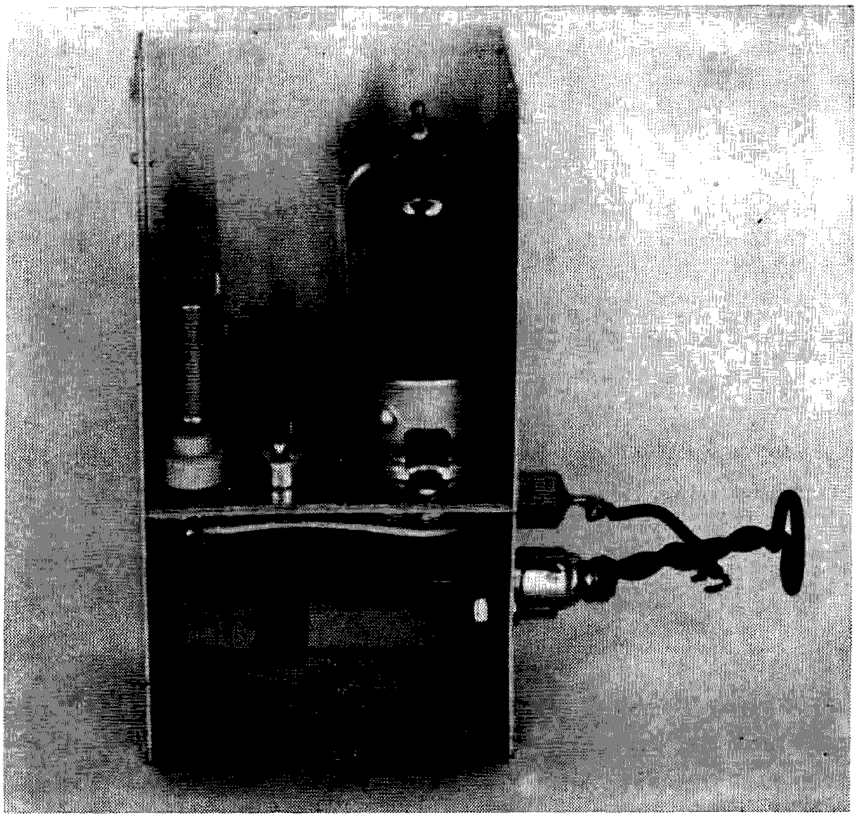
The setting of C1, C4, and the inductance of L1, L2, and L3 will affect the noise figure and are given in the order of importance. Tune in a very weak unmodulated signal and adjust the above five components for the best signal, *consistent* with *minimum* noise. It should be stressed that the point of maximum signal strength *will not* be the proper setting for the best signal-to-noise ratio, or produce the lowest noise figure. By using a "tuning wand" (brass core at one end, powdered iron at the other) check the inductance of each coil. If the brass core improves the noise figure, spread the turns. If the iron core brings about an improvement, compress the turns. The tap point on L1 probably will not require adjustment. However, if the noise figure seems to be best with maximum C1 capacity, move the tap one-half turn toward the "hot" end. Of course the opposite is true for minimum capacity.

To obtain a noise figure which is less than 3 db, you will require a noise generator such as the one shown in Fig. 3. Although this device cannot measure the noise figure, it will tell you when you have arrived at minimum. Its operation is just as simple as the circuit. Connect a dc voltmeter across the diode load in the receiver. Then adjust the noise figure determining components in the rf amplifier for a maximum increase in noise each time the generator is switched on. You will find that each adjustment goes through a minimum and this, of course, is the correct setting.

Obtaining the WE417A

The rf amplifier tube, a WE417A, is made by Western Electric and is not available through regular distribution channels. If you know someone who works at a television sta-

Location of the components inside the oscillator compartment.



tion, they are used in the studio-transmitter microwave links. As a precaution they are usually retired after a certain number of hours of service, but are in excellent condition. The same is true for the telephone company. Their microwave equipment uses hundreds of these tubes and they are often "pulled" if the equipment is taken out of service for short periods. Wholesale tube suppliers, such as Barry, TAB, and JSH Sales, have the WE417A at very reasonable prices. If you prefer to purchase one directly from Western Electric they are available at Graybar Distributors (listed in the phone book) for approximately $15.00. Don't shudder, fellows, this jug makes the difference between the men converters and the boy converters, so to speak.

Using the Converter

For best performance the converter should be used in conjunction with a very stable receiver. The sensitivity is not particularly important for the converter has a considerable amount of gain even without an if amplifier. On voice, a bandwidth of 2.5 kilocycles is optimum, while something less than 500 cycles is preferred on CW. An additional consideration is the tuning ratio. A station 3.5 kc wide does not take much room on a dial which covers 10 or more megacycles.

The WE417 is allergic to strong rf fields. The rf energy which leaks through an open antenna relay *could* wipe out the delicate grid in the twinkling of an eye, if the transmitter power is high enough. Some form of protection must be included in the converter connections. The most satisfactory system is to incorporate a second antenna relay in series with the converter input. When the main relay switches the antenna from the converter to the transmitter, a second relay disconnects the converter input from the antenna relay and grounds it.

Earlier it was stated the converter was used on the 108 mc satellite frequency. An extra set of coils were wound up which can be interchanged with the two meter coils in about 5 minutes. Although bandchange switches are impractical at this frequency the conversion from one band to the other is quite simple. Builders who would like to use the converter on 108 mc, in addition to two meters, should make the following changes:

L1—4 turns, #16, ⅜" diameter, centertapped
L2—20 turns, #24 enam., closewound, ¼" diameter
L3—6 turns, #16, ⅜" diameter
L4—same as L3, but 5 turns
L5—same as for 144 mc
L6—same as L3, but 4 turns
L7—same as for 144 mc, but remove C15
L8, L9—same as for 144 mc
X1—45.667 mc, *if* 29.0 mc

For simplicity, and ease of changing from 144 to 108 mc, the same 45.667 mc crystal is used on both bands. On two meters the local oscillator is 7 mc below the low end of the band. When the 108 mc coils are substituted, the oscillator is then 29 mc above the satellite frequency.

References

1. **Cottony and Johler,** "Cosmic Radio Noise Intensities in the VHF Band," Proc. IRE, Sept., 1952, p. 1053.
2. **Bray and Kirchner,** "Antenna Patterns from the Sun," QST, July, 1960, p. 11.
3. **Southworth,** "A Low-Noise 108/144 mc Converter," QST, Nov., 1956, p. 11.
4. **Tilton,** "Hints on Lowering Noise Figures," QST, Nov., 1953, p. 65.

Reference 3 lists additional reading for those interested in noise with respect to high frequency equipment.

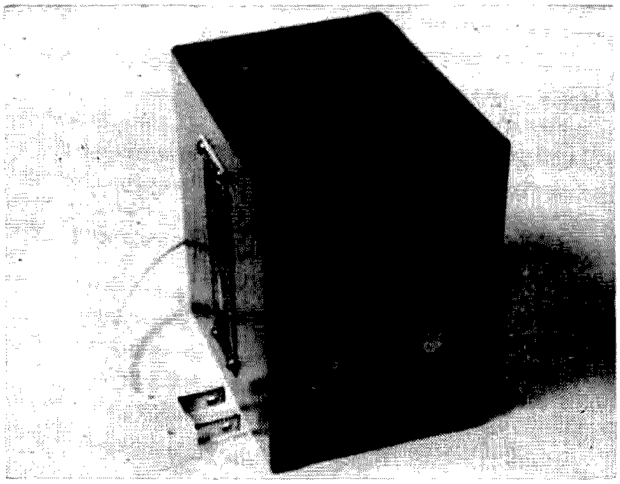
PARTS LIST

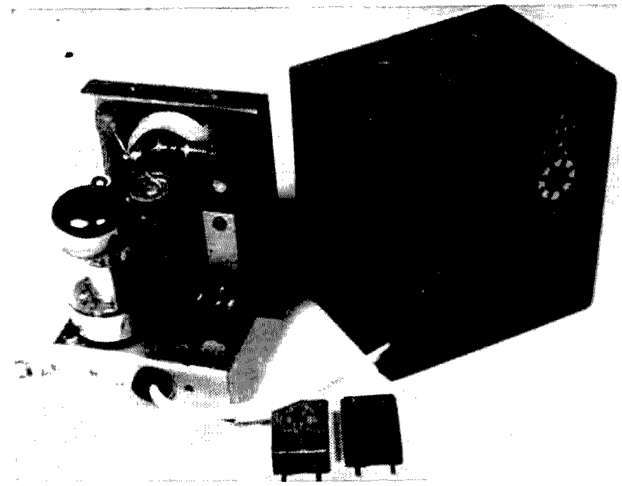
C1, C4- 7- 45 mmfd. rotary trimmer (Centralab type 822)
C2, C5, C12, C14- 500 mmfd tubular ceramic (Centralab D6-501)
C3, C15- 56 mmfd tubular ceramic (Centralab D6-560)
C6, C9, C27- 500 mmfd button standoff (Centralab type ZA)
C7 C13, C16, C17, C18, C23, C26, C28- .001 mfd disc ceramic
C8, C11- 1- 7 mmfd piston trimmer (Centralab 829-7)
C10- 3.3 mmfd disc ceramic
C19, C21, C22, C25- .001 mfd feedthrough capacitor (Centralab type FT)
C20- 80- 40 mfd, 150 volt electrolytic (Sprague TVA 3455)
C24- 20 mmfd disc ceramic
F1- 3 ampere fuse (Littlefuse 3AG)
J1, J2- UHF style antenna connector (amphenol SO-239)
L1- 5 turns, #16, ¼" diameter, spaced two-times wire size, centertapped.
L2- 15 turns, #24 enam., ¼" diameter, closewound
L3- 3½ turns, #16 enam., ⅜" diameter, spaced two-times wire size
L4- 4 turns #18, ½" diameter, spaced two-times wire size
L5- 1 turn hookup wire line, at cold end of L6 (see photo)
L6- 2½ turns, #18, ½" diameter, spaced two times wire size
L7- 35 turns, #38 enam., scramble wound on ¼" diameter slug tuned form (see text)
L8- 4 turns, #28 enam., spaced two-times wire size on ¼" slug tuned form. One turn link of #28 wire
L9- 7 turns, #28 enam., closewound on ¼" diameter slug tuned form
L10- Choke, 5 hy., 50 ma (Stancor C1325)
LA1- #47 pilot lamp and holder
R1- 75 ohms, 5%
R2- 82 ohms, 5%
R3, R11- 39K
R4- 270K
R5- 1.5K
R6- 10K

All resistors ½ watt, unless noted otherwise

R7- 1K
R8- 22 ohms, 2 watts
R9- 470 ohms
R10, R12- 150 ohms
RFC1, 2- 30 turns, #30 enam. closewound on 1 meg., ½ watt resistor
RFC3- 15 bifilar turns wound on two 1 meg., ½ watt resistors
RFC4- 7 turns, #16 wound on 1 meg., ½ watt resistor, spaced diameter of wire
S1- SPST toggle switch
SR1- 50 ma. selenium rectifier
T1- power transformer, 125 volts, 50 ma., and 6.3 volts at 2 amperes (Stancor PA8421)
V1- WE417 (Western Electric)
V2- 6AM4 (General Electric)
V3- 6BQ7
V4- 12AT7
X1- Third overtone crystal (International FA-5, see text)


NOW ALL YOUR POWWOWS
CAN BE PRIVATE WHEN EVERYONE
IN THE WIGWAM KNOWS YOU'RE...
ON THE AIR
ON THE AIR
WITH A COMANCHE
CONTROLLED ILLUMINATION SIGN
● HEAVY GAUGE STEEL CASE
● BRIGHT RED LETTERS ON WHITE
● BLACK OR GRAY BAKED FINISH
● WALL OR TABLE MOUNTING
● AC-DC 6-12-120V (SPECIFY)
● JUST RIGHT FOR YOUR SHACK ●
ONLY
6.95
NET
TO INSTALL SIMPLY CONNECT LEADS TO THE COIL OF YOUR ANTENNA CHANGEOVER RELAY. WHEN YOU "FLIP" TO TRANSMIT YOU ARE ON THE AIR.
AVAILABLE
IN OTHER
LANGUAGES
7.95
NET
COMANCHE PRODUCTS
STELLAR ELECTRONIC
BOX 82
GARLAND, TEXAS
WHO IS MY
NEAREST DISTRIBUTOR?
NAME
CALL
ADDRESS
STATE





Surplus Frequency Standard

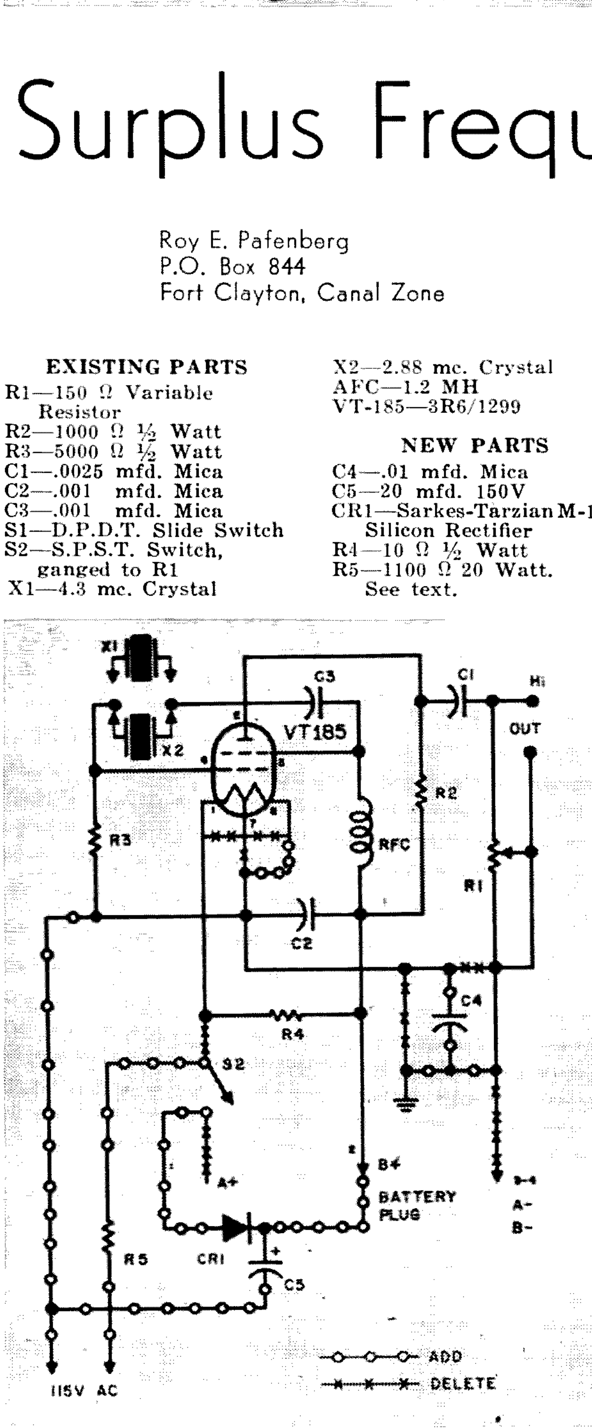
Roy E. Pafenberg
P.O. Box 844
Fort Clayton, Canal Zone

EXISTING PARTS

R1—150 Ω Variable Resistor
R2—1000 Ω ½ Watt
R3—5000 Ω ½ Watt
C1—.0025 mfd. Mica
C2—.001 mfd. Mica
C3—.001 mfd. Mica
S1—D.P.D.T. Slide Switch
S2—S.P.S.T. Switch, ganged to R1
X1—4.3 mc. Crystal
X2—2.88 mc. Crystal
AFC—1.2 MH
VT-185—3R6/1299

NEW PARTS

C4—.01 mfd. Mica
C5—20 mfd. 150V
CR1—Sarkes-Tarzian M-150 Silicon Rectifier
R4—10 Ω ½ Watt
R5—1100 Ω 20 Watt. See text.



An appealing little item of surplus, still in fairly common supply, is the VO-4 Oscillator. The unit is a compact, battery operated, dual frequency, crystal controlled signal generator. The original application of the instrument was as a signal source for use in the alignment of the 2880 and 4300 kc if circuits of the SCR-510 and SCR-610 series of field radio sets.

While crystals for the above frequencies are supplied, the circuit works nicely with crystals from 1 to 12 mc. The simplicity and utility of the unit as a 1 mc standard or as a band edge marker, makes conversion to ac worthwhile.

Fig. 1 shows the schematic of the unit as supplied, with the necessary changes and ac power supply. The slightly unorthodox wiring of the power supply permits best utilization of component terminals as tie points. The other changes lift the circuit from chassis ground and series the filament sections of the 3D6/1299 tube.

The photographs show the mechanical details of the conversion. The crystals and the silicon rectifier were removed for clarity in the photograph. The battery cable is removed and the ac cord secured with a Heyco strain relief bushing. The bracket for the crystal retaining spring is drilled to mount the Sarkes-Tarzian M-500 or M-150 silicon rectifier. The required filament dropping resistor, in the authors version, consisted of a 1000 ohm, 10 watt adjustable resistor, mounted in an existing hole, in series with a 750 ohm, 10 watt, fixed resistor. Any combination that results in approximately 1100 ohms at between 15 and 20 watts will be satisfactory.

All in all, the compact construction and versatility of this crystal controlled signal source make it a desirable project for any ham shack.

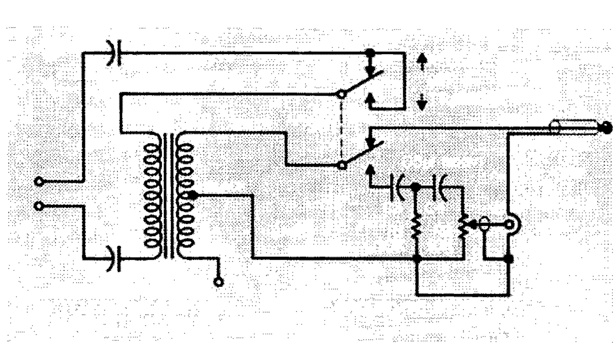
73

A Simple And Efficient Phone Patch

Herbert S. Brier, W9EGQ
385 Johnson Street
Gary 3, Indiana

SIMPLICITY, economy and efficiency are the features of the phone patch described here. T1, a single plate to push pull grid audio transformer with a 1:2 turns ratio (Stancor A-520) is used as a 1:1 coupling transformer between the telephone line and the receiver and transmitter by using only half of its secondary winding. Capacitors C1 and C2 isolate the dc in the telephone line from T1. Capacitors C3 and C4 and resistors R1 and R2 act as a filter to keep the hum and other low frequency noises frequently heard on phone patches from modulating your transmitter.

When SW1, a dpdt neutral-center (switchcraft 30374) lever switch, is in the center position, the patch is completely disabled. When it is in the "Receive" position, the signal from the receiver is piped into the telephone line via PL1, which is plugged into the receiver phone jack. Alternatively, it may be connected to the 500-ohm output terminals of the receiver. Signal level is controlled by the radio receiver volume control and should be no louder than your own voice in the telephone receiver. When SW1 is in the "Transmit" position, the signal from the telephone line is fed into the microphone input jack of the transmitter. Its level is controlled with R2.



The patch is built in a 4" X 4" X 2" metal box (Bud CU-883). Parts arrangement is not critical. My microphone is the type with a connector right on it; therefore, to use the patch, I unscrew the transmitter microphone input cable from the microphone and screw it on PL1. Use shielded microphone cable between the patch and the receiver and the transmitter.

As there are miles of unshielded telephone line connected to the patch when it is in operation, it is not necessary to use shielded wire between it and the telephone line.

Results

While I take a dim view of the practice of running phone patches just to be running phone patches, this patch has been used to keep a regular phone-patch schedule with Antarctica on sideband for a year. Also, it has been used to run phone patches with many o the other foreign countries with which suc traffic is permissible both on AM and SB. I works as well as any other patch I have hear or used and better than many of them.

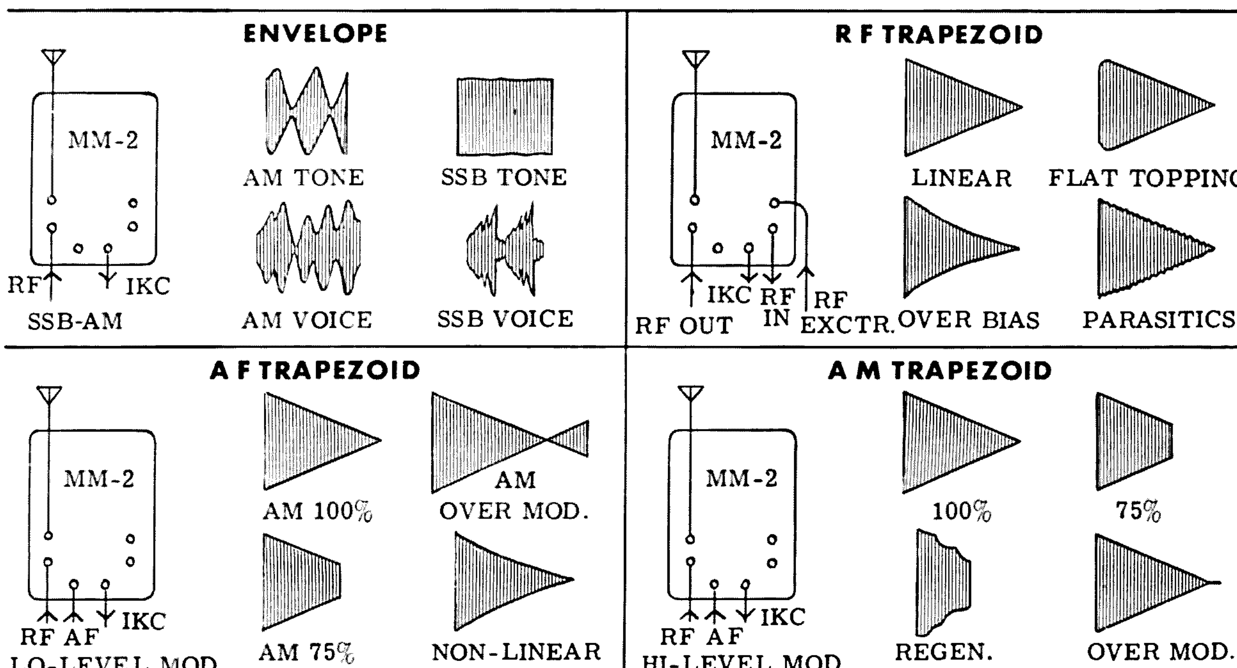
Although it does not permit "voice breakin" on sideband, this is usually an advantage, because it prevents both parties from talkin at the same time, as often happens when inexperienced people are patched into each othe via hybrid patches.

THE MULTIPHASE MODEL MM-2 *RF* ANALYZER

- Monitors the RECEIVED and TRANSMITTED signals. Shows flat-topping, overmodulation, parasitics, keyed wave shape etc. Silent electronic switching keyed by transmitted RF.
- No tuning required. Broadband response flat 1 MC to 55 MC at power levels of 5 watts to 5 KW.
- New variable sweep control for transmit and receive.
- RF attenuator controls height of pattern. Calibrated in 3 DB steps.
- Function selector for ENVELOPE, TRAPEZOID and BOW-TIE patterns on transmit. For SSB, DSB, AM and CW.
- Built-in 1 KC audio oscillator, less than 0.5% distortion. With 3" scope, is ideal for complete alignment of SSB exciters.
- For use in series with 52-72 ohm coax lines. A short pickup antenna may be used with other systems.
- Plug-in adaptors available to match 50 KC, 60 KC, 80 KC or 455 KC receiver IF systems. Only one simple connection to receiver.

MM-2 Kit ... (less IF adaptor). $119.50
Wired ... (less IF adaptor). $149.50
Plug-in IF adaptors (wired only) ......
RM-50 (50 KC), RM-80 (60-80 KC),
RM-455 (450-500 KC)... ea. .. $12.50

THERE IS NO SUBSTITUTE FOR A SCOPE IF YOU WANT THE CLEANEST, MOST PERFECTLY MODULATED SIGNAL YOUR TRANSMITTER CAN PROVIDE. THE MM-2 IS BY FAR THE MOST DEPENDABLE and EASIEST TO USE, SINCE IT WAS DESIGNED STRICTLY FOR THIS PURPOSE.



OTHER FINE C.E. PRODUCTS

Model 100V	New 100 Watt Broad-Band Exciter-Transmitter	$795.00
Model 600L	Broad-Band Linear Amplifier	$495.00
* Model 20A	Bandswitching SSB Exciter	$299.50
* Model 10B	Multiband SSB Exciter	$193.50
* Model GC-1	Gated-Compression Amplifier	$ 66.50
* Model B	Sideband Slicer with Q Multiplier	$104.50

* Also available in kit form
AND MANY OTHERS ... WRITE FOR LITERATURE

THE SSB PIONEER

MULTIPHASE EQUIPMENT

Central Electronics, Inc.

1247 W. Belmont Ave. Chicago 13, Illinois
A subsidiary of Zenith Radio Corp.

New Tube Base Coil Forms

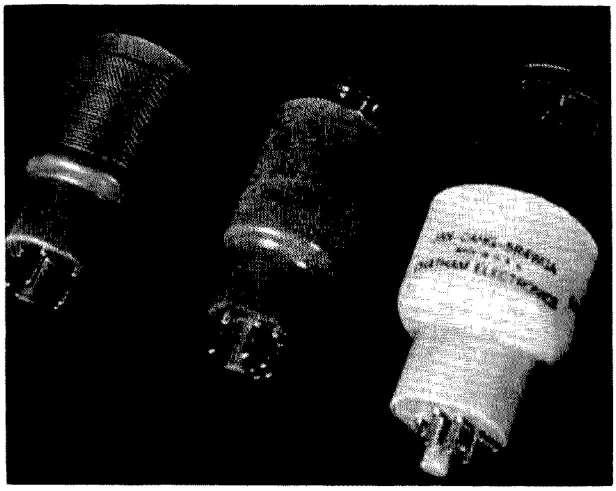


Photo credit: Jim Gardner

Fort Clayton

THE use of tube bases for plug-in coil forms is probably as old as the vacuum tube.

In an effort to make certain tube types more reliable in rough service applications, shock mounting tube bases have been developed. Shown are two representative tubes with bases that make excellent coil forms. The OC3W voltage regulator tube has a mica filled phenolic base 1½" in diameter and a usable winding length of 1¾". The 5R4WGA has a similar insulating base, slightly over 2" in diameter, with a winding area of 1$\frac{3}{16}$".

While the use of these "no cost" coil forms will not obsolete band switching transmitters and receivers, they do add to the range of available coil form materials.

Book Reviews

Surplus Radio Conversion Manual Volume III

The best selling books for several years now have been the various surplus conversion manuals and handbooks. There seems to be an insatiable demand for information on how to convert the world's best radio bargains to useful ham equipment. You will find a fairly complete listing of the available books on surplus equipment in the Radio Bookshop ad on page 60.

There is far too much info in this volume to go through it item by item. Here are some of the articles in this 88-page book: Converting the Command Receiver (3-6 mc) to Six Meters; Making a Novice Receiver for 40 and 80 Meters from the 3-6 mc Command Receiver; A Plug-in Power Supply for Your Command Receiver; Converting the Q-5'er (BC-453) for Broadcast Reception; A Noise Limiter for Your Command Set; AVC for Your Command Set; Double-Conversion Command Receiver for SSB Reception; Converting the BC-455 for 20-15-10 Meters and Citizens Band; Hopping Up the Command Receiver; Converting the BC-603 to a 10-15-11 Meter AM/FM Receiver; Plus articles on the APN-1, CRC-7, URC-4, MD-7, RM-52/53, 701A tube, ARC-5 transmitters, BC-1253 transmitter, BC-1066, APN-4, MBF, R-28, ARC-4, SCR-522, BC-312, BC-342, BC-348, BC-375 & 191, ART-13, LM. There are schematics of many other surplus items in additions. The book is edited by Bill Orr W6SAI.

All this for only $2.50. It's a good deal.

Television Servicing Handbook

Those of you who spend much time servicing British TV sets with British test equipment will find this 280-page hard-cover invaluable. They sent it to us for review and we'd be doing them less than fair if we were to hold back the news that this volume is in print and is rather well done. The price is listed at 30s, or about $4.20. I suspect that it may run just a bit over that by the time it has been shipped over here. It is published by Odhams Press Limited, Long Acre, London. Radio Bookshop will import it for you if you want to avoid the paperwork . . . see ad page 60.

. . . so you want to be a HAM

This 188-page book by Robert Hertzberg W2DJJ is the second edition, completely revised and enlarged, of this successful idea. Chapter I tells all about our hobby, the various types of licenses, what we do, etc., complete with plenty of interesting pictures. Chapter 2 goes into methods for learning the code. From there on the book takes on the proportions of a giant catalog, showing pictures and giving brief complimentary descriptions of just about every possible piece of commercial ham gear. Bob is probably closer than the Handbook, with all its construction projects, to the present day spirit of our hobby. Old timers will remember when the problem was to decide what tube to use in the final . . . now we have to make the big decision about what brand of equipment we are going to buy. $2.95.

Echo Echo

Staff

This should be called Hard Facts About Echo, Part II, I suppose. The hard facts are that we ran an article last month by Don Goshay W6MMU which went on to prove that you can get a better bounce from the moon than you can from elusive "Echo" x and somewhere down in the print shop the chart which went with it became lost. Here is the chart. With this chart you can figure out ahead of time just how much signal you can expect to get back from what type of reflector. The next time some joker starts to tell you about the S-9 signals he got back on two meters when Echo was passing over you can whip out this chart and set him to looking for other phenomenon to explain his experience.

ECHO CHART

Band width	Add	Band	Add	Power	Add
5 mc	—30 db	144 mc	—19 db	12½ watts	—16 db
50 kc	—10 db	220 mc	—15½ db	125 watts	— 6 db
5 kc	0 db	432 mc	— 9½ db	250 watts	— 3 db
500 cps	10 db	1296 mc	0 db	500 watts	0 db
50 cps	20 db	2400 mc*	5½ db	1 kw	3 db
10 cps	27 db			10 kw*	13 db
5 cps	30 db				

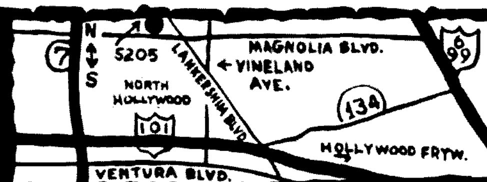
Dish Diameter	Add	Noise Figure	Add	Satellite Diameter	Add
2 feet	—6 db	2 db	0 db	100 feet	0 db
4 feet	0 db	4 db	— 2 db	1000 feet	20 db
6 feet	7 db	6 db	— 4 db	2000 feet	26 db
8 feet	12 db	8 db	— 6 db	Moon at	0 to 6 db
10 feet	16 db	10 db	— 8 db	239,000 mi	(see text)
12 feet	19 db	12 db	—10 db		
84 feet*	53 db				

Note: "Add" indicates plus valued corrections are to be applied in the direction of improved system performance.

Example: If a ten foot dish is used on 2400 mc with a transmitter output of 250 watts, a receiver bandwidth of 500 cps, and a receiver noise figure of 4 db, we would have a correction of $+16+5\frac{1}{2}-3+10-2=26\frac{1}{2}$ db. Since we started with a reference of 20 db below the noise, our plus 26½ db correction would give us an expected signal of 6½ db over the noise!

*Asterisk indicates situation of JPL Tracking Facility at Goldstone, California.

ALVARADIO
NEW HAM HEADQUARTERS GRAND OPENING SPECIALS



STORE HOURS:
Daily & Saturday—
9 a.m. to 9 p.m.
Sunday—11 a.m. to 6 p.m.

You have dealt with WOODY before. Well; he's at it again, wheeling and dealing. Xmas money waiting for you. Come in and visit our special Ham section.

YOU ARE WELCOME TO COME IN AND BROWSE AND DISCUSS YOUR PROJECTS.

WOODY K6BXW

W6ATC HARRY

WA6NBM JIM

CASH

for your old gear. . . . Get that buried money out of your garage, attic and basement. Clean out your old equipment. We buy used Ham gear, Commercial, Surplus. We're looking for all components of: GRC, I, PRC, SCR, BC, TS, IE radio and test equipment.

Westinghouse 0-50 ma 3" square meter $2.50
WE tel. hand sets 1.49
Speakers ....1.39 and up
Coiled cords 3 cond.... 88¢
Coiled cords 4 cond.... 98¢

CHECK THESE PRICES COAX CABLE SPECIAL

RG-8A/U .... 8¢ ft.
RG-9A/U .... 10¢ ft.
RG-7/U .... 9¢ ft.
RG-59A/U .... 5¢ ft.

All in 500 foot spools.
Any length cut to order.

SCR 625 Mine detectors $19.95
AN/PRS 3 Mine detectors, late models .. 33.50
100C crystal mike ... 3.88

Gonset 10-11 converter 7.95
Gonset Comm. II 2M. 149.50
Gonset Comm III 2M . 185.00
Gonset Comm IV 294.50
BC 620 new boxed extra tubes 12.95
30-40 mc mobile 25 watts 6v power supply, Xmitter - Rcvr exc. condition 34.95
ART 13 Crystal calibrator 3 tubes, 200 kc xtal 3.95
Magnetic bulletin board a must for ham shack 1.49
New Silicon 750 MA rectifiers .... 27¢ ea.
Ferris mod 22A 85kc to 25mc 6 bands Sig. Gen. microvolter. A lab inst. 88.88
BC 683 27-39 mc FM-AM. Police, fire, paging. Extra set of tubes. New 34.50

Now: Gonset & Hallicrafters Distributor

Volt-ohmeter 1000 ohms per volt, pocket size AC-DC Ohms.. $6.88
Keys .... 88¢
829B new boxed 3.95
4X125 pair 17.00
4X150 new 7.95
Coax fittings .... 29¢

NEW WINTER CATALOG
Write for yours today.

2M Transmitter 100W input one package table-top size 115v 60cps power supply & ant relay built in. 829 final screen mod. Complete $59.50

ALVARADIO INDUSTRIES A DIVISION OF STANDARD ELECTRONICS, INC.
5205 LANKERSHIM BLVD. NORTH HOLLYWOOD, CALIF. TRiangle 7-2113

All Over the World . . . DX-ing MERRY CHRISTMAS with

COSMOPHONE "1000"

Gledelig Jul

BUONE FESTE

NATALIZIE

GLAD JUL

Feliz Navidad

Joyeux Noël

▲ A Self-contained 1 KW Transmitter-Receiver

▲ A True Table-top Station with NO Sacrifice of Performance

SPECIFICATIONS

TRANSMITTER

INPUT: Full 1 kw on Voice Peaks (Meters Read 2500 V at 400 ma) into a pair of 4 x 300 A's

UNWANTED SIDEBAND: 42 db down

DISTORTION (SSB): Third order products approx. 32 db down

FREQUENCY STABILITY: Drift less than 100 cycles

CALIBRATION: Built-in 100 kc marker

AUDIO CHARACTERISTICS: 200-3100 cps

MIKE INPUT: High impedance

VOX: Built-in

LEVEL: Automatic level control

METERING: Screen, plate, and grid current, plus RF output

RF OUTPUT: 52 ohms

VFO's: Dual VFO's permit transmitting on the receive or any other frequency

CONTROLS: Vox, Qt, ALC, Grid Tuning, Plate Tuning, Antenna Loading, Audio Gain, Band Switch, Meter Switch

RECEIVER

SENSITIVITY: 1 microvolt for 6 db S/N

SELECTIVITY: 3.1 kc mechanical filter plus a T-notch filter

STABILITY: Drift less than 100 cycles from a cold start at room ambient

TUNING KNOBS: Coarse gear ratio of 20:1, fine gear ratio of 100:1 gives a 1 kc dial reading per division

CALIBRATION: Built-in 100 kc marker

IMAGE AND IF REJECTION: Better than 50 db

AUDIO DETECTOR: Balanced detector for SSB and CW, diode detector for AM

MODE SWITCH: Selects up or low SSB, or up low AM, or CW

DUAL RECEPTION: Two VFO's permit reception of any two frequencies on one band with the flick of a switch

BFO: Crystal controlled

METERING: S-meter

CONTROLS: T-notch filter, audio gain, RF gain, antenna trimming, tune selector, phone jack, tune A and B

"The **COSMOPHONE 1000**"—a complete Station, Receiver, and Transmitter.
Dimensions: 17 inches wide, 12 inches high, and 15 inches deep.
Power Supplies packaged separately, can be placed under operating desk.
Price: "The **COSMOPHONE 1000**" with Power Supplies . . . **$1,550.00.**

A Product of *For additional information and dealer nearest you, write Dept. 73-12*

COSMOS INDUSTRIES, INC.

31-28 QUEENS BOULEVARD
Long Island City, N. Y.

LETTERS

Arkansas VHF

Dear Wayne,

We've enjoyed your pearls of wisdom from time to time, but let us say that 73 is the Most . . . really have enjoyed my copies. We are looking forward to a real cool VHF section in your new sheet.

In working the various VHF bands we often hear this plaintive cry—"Why don't you guys in Arkansas get some activity on Six, Two or One and a quarter (as the case may be)." As the lawyers say, "I wish to refute this plea." We in Arkansas have activity plus on Six and Two and the beginnings of activity on 220 mc and 432 mc. Down in central Arkansas the VHF activity is very ably stirred by the Arkansas VHF Club and its associated nets, the Central Arkansas Emergency Net and its associated club.

The Arkansas VHF Club had its beginnings in the old Wonder State Net way back in 1956. The active president is Ike Roland K5GOW of Malvern. The club net on Six covers from Forrest City to Conway and from Searcy to Texarkana with relay coverage of the state. At present the net numbers 36 members on Six and 9 members on Two.

The Central Arkansas Emergency Net covers Pulaski County and the counties that touch it on Six and 75M. At present we have 26 mobile units on 6M narrow band FM with almost complete coverage of the area from six base stations.

Net	Frequency	Night	Time	NCS
Ark. VHF Net..	51.0	Tues.	2000	K5OZE/K5EZI
Cent. Ark. Emg. Net	51.0 NBFM 50.25	Thurs.	2000	K5CQP/W5TIE
Ark. VHF Net..	145.05	Thurs.	2100	W5TIE/K5EZI

In addition to the above we have two Air Force MARS nets operating in the area on Six. The 51.0 mc frequency in Arkansas is almost constantly monitored from 1700 until 2300 as is the NBFM frequency at 50.25 through the day from 0730 until 1700 and later. The 145.05 frequency on Two is sampled hourly from 2000 until 2300.

The Arkansas VHF Club is setting Spring 1961 as the target date for net operation on 220 mc and on 432 mc. Several of the fellows have gear that will operate on these frequencies now. We're in VHF up to our XYL's necks, just ask mine!

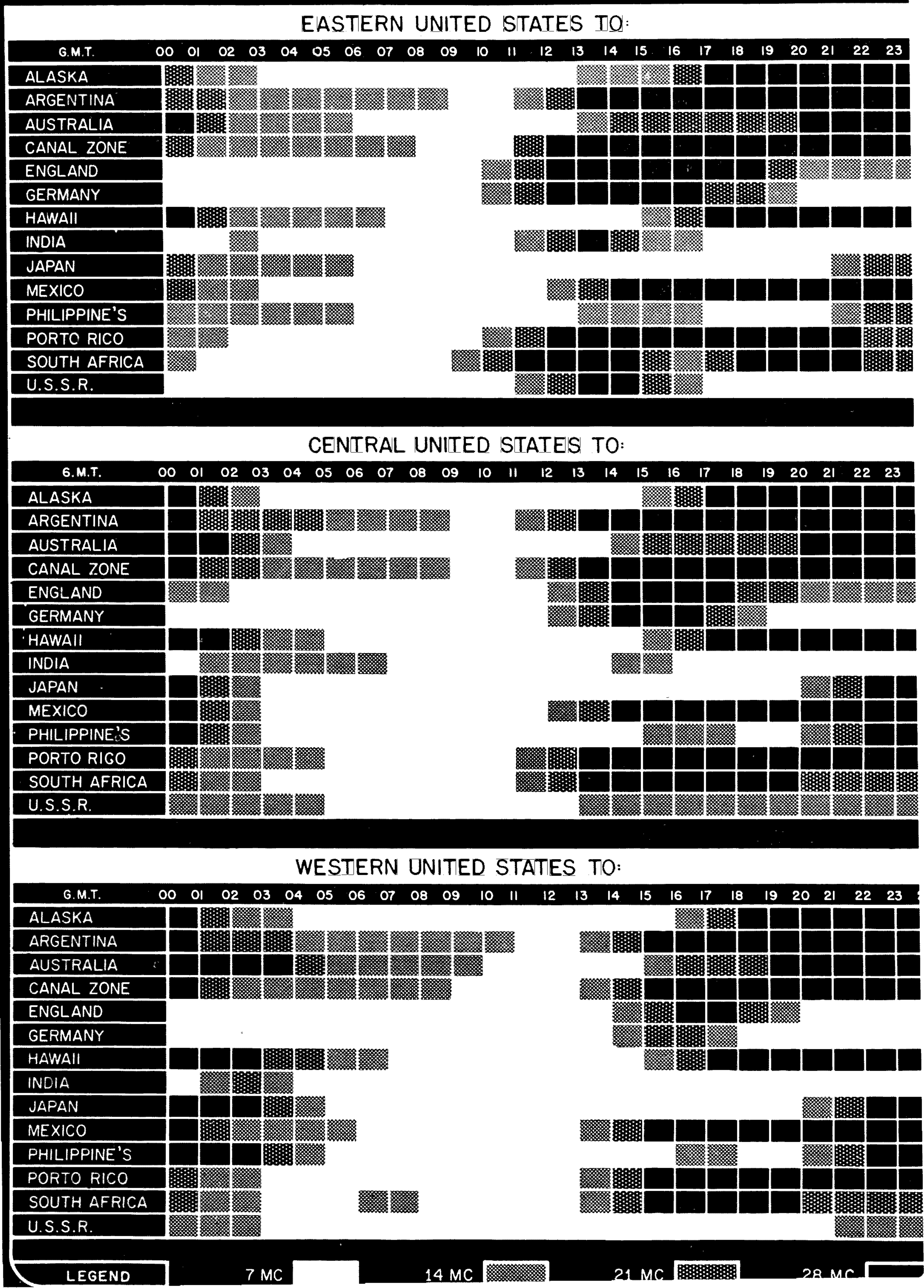
Jake K5EZI

I'll be listening for you and the gang with my ground plane pointed your way Jake . . . Wayne.

Decoding the Address Label

In addition to your name and address on your label you will find the usual hieroglyphics. Our system is deucedly simple since we didn't have anyone with enough experience to work out a complicated one. The first two numbers tell us when you first subscribed . . . 80: eighth month of 1960. The last two tell us which is the last issue to send . . . 92: September 1962. To get away from the nuisance of using extra numbers we use an "N" for November, and guess what for December. Code appears under the address.

PROPAGATION CHART



Technical Broadcasts

You really ought to listen to the interesting talks being given each Sunday from 2-4 p.m. (EST) on 3295-7540-15,715 kc.

Dec. 4—David P. Sarett: Principles of Guidance and Navigation, and Inertial Devices.

Dec. 11—G. W. Davidson: Analog and Digital Computers.

Dec. 18—J. Foster: Design and Application of Special Development Test Equipment.

Jan. 8—R. R. Darden: Exotic Applications of Semi-Conductors.

(All speakers are from the American Bosch Arma Corporation).

(There will be no broadcasts on the Christmas and New Year Sundays).

New Product

Gonset G-63

This new receiver by Gonset nets for a bit under $250 and has a lot of interesting features. It is a ham-band only receiver and covers 80 thru 6 meters. It has separate second detectors for SSB/CW and AM, a peaking Q-multiplier and temperature and voltage compensated HF and BFO oscillators. Drop a card to Gonset Division, Young Spring & Wire Corp., Burbank, California for more details and a bigger picture. Tell 'em you saw it in **73**, even if you didn't. Or tell 'em you didn't see it in **73**. Just get **73** in there somewhere.

Propagation Charts

David A. Brown K2IGY
60 New York Avenue
West Hempstead, N. Y.

The bands listed are MUFs and a higher band will not work for the time period listed. Lower bands will work, but not nearly as well. Times are GMT, not local time.

These charts are to be used as a guide to ham band openings for the month of December, 1960 to the various countries listed. I will be interested to hear of your results in using these charts and to know what other areas you might wish included in future charts.

Advanced Forecast: December 1960

All days good except Fair on 5-6, 30-31. No bad days!

Vagabond Ham

A vagabond's life is the life I live
Along with others, ready to give
A friendly laugh and a word of cheer
To each vagabond friend, both far and near.

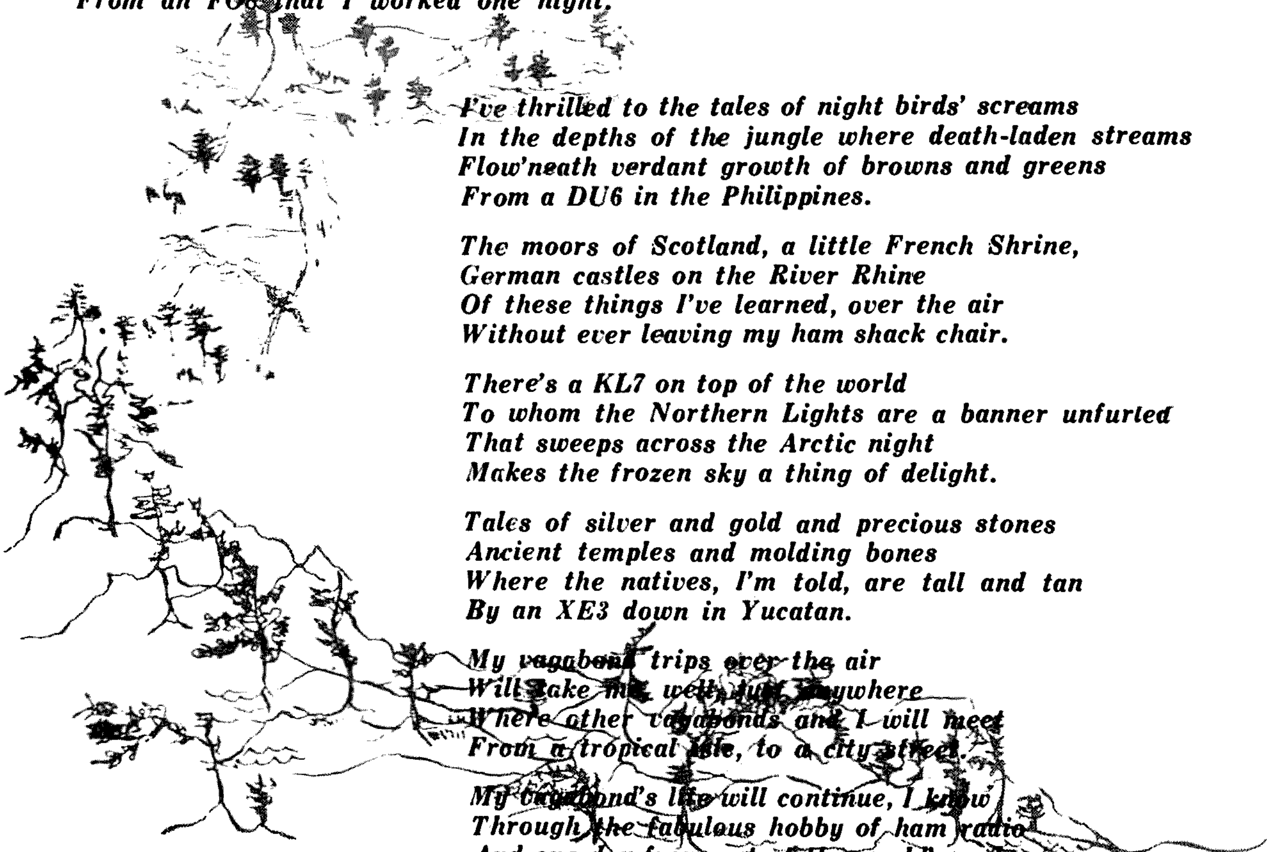
I travel the air waves, day or night
To visit places I'll never sight
From the rail of a ship, or from a plane
Yet I'll visit them all again and 'again.

I never hear from a far off land
That my pulse doesn't quicken. With careful hand
I tune my receiver and VFO dial
To make a new friend and chat for awhile.

Africa, Asia, they're all quite near
In as easy reach as my radio gear
With the flip of a switch, the turn of a knob
I can work a ZL, a friend named Bob.

There's an LU4, a fellow that's grand
Who's described to me his native land
'Till I can hear the birds, and feel the breeze
As it blows from the slopes of the mighty Andes.

I learned of the surf, and a coral strand,
The smell of hybiscus where palm trees stand
'Neath a tropical moon, silver and bright
From an FO8 that I worked one night.



I've thrilled to the tales of night birds' screams
In the depths of the jungle where death-laden streams
Flow'neath verdant growth of browns and greens
From a DU6 in the Philippines.

The moors of Scotland, a little French Shrine,
German castles on the River Rhine
Of these things I've learned, over the air
Without ever leaving my ham shack chair.

There's a KL7 on top of the world
To whom the Northern Lights are a banner unfurled
That sweeps across the Arctic night
Makes the frozen sky a thing of delight.

Tales of silver and gold and precious stones
Ancient temples and molding bones
Where the natives, I'm told, are tall and tan
By an XE3 down in Yucatan.

My vagabond trips over the air
Will take me, well, just anywhere
Where other vagabonds and I will meet
From a tropical isle, to a city street.

My vagabond's life will continue, I know
Through the fabulous hobby of ham radio
And one day from out of the world's end
We'll meet on the air, my Vagabond friend.

Ken Johnson W6NKE

(. . . de W2NSD continued from page 7)
nonth period so we could find out specs and prices without having to send for that "further information" which takes from days o weeks to arrive? Even a brief listing would e helpful.

This could get to be pretty prohibitive if it veren't for the low advertising rates of 73. A quarter page ad is still only $40.

Audio Booster Note

Jim Kyle points out that the value of R13 n the circuit may have to be changed to alance things if your rig has an input impedance which is different than his. If you've had any trouble in getting a balance this should help. For instance with a 1 megohm mike and a 1 megohm input R13 would have o be 2.2 megohms.

Chortle

Propagation forecasting, like weather forecasting, is divided into several schools of thought.

In comparing the Propagation Charts in the November 73 with those in other ham magazines I was surprised to notice that Dave Brown had forecast the period of November 12-15 as one of very bad conditions, while the other forecaster had promised that these dates would produce the best conditions of the month.

While visiting the Voice of America studios on November 16th to record a program for the VOA Ham show, Bill Leonard W2SKE and Gene Kern W2BAK discussed at length the worst radio blackout in recent years which struck from November 12-15.

Congratulations K2IGY and keep up the good work. I'll bet you were really worried when the National Bureau of Standards issued their November 9th advanced forecast for November 10-16th and predicted normal conditions.

News Clippings

Marvin Lipton VE3DQX, in addition to sending out a monthly bulletin to all editors of club bulletins to help them get news for their publications, will be exerpting news items which have made the newspapers for us to print in 73. Please scan your local paper carefully and send Marvin anything hammy that creeps in. Or send it to 73 and we'll forward it up to Marvin for condensing. Send it in, good or bad, to Marvin Lipton VE3DQX, 311 Rosemary Road, Toronto 10, Ontario, Canada.

Shorts

I hate to embroil you in editorial problems, somewhat. Bluntly put: we need more short items, stuff that obviously doesn't require full

(Continued on page 57)

Name .... Call .... $3 yr.

Address .... $5 2 yrs.

City .... Zone ...... State .... $4 yr. DX

.... years. Start: Oct.— Nov.— Dec.— Jan.— (Check one)

73 Magazine; 1379 East 15th St., Brooklyn 30, N. Y.

Name .... Call .... $3 yr.

Address .... $5 2 yrs.

City .... Zone ...... State .... $4 yr. DX

.... years. Start: Oct.— Nov.— Dec.— Jan.— (Check one)

73 Magazine; 1379 East 15th St., Brooklyn 30, N. Y.

Name .... Call .... $3 yr.

Address .... $5 2 yrs.

City .... Zone ...... State .... $4 yr. DX

.... years. Start: Oct.— Nov.— Dec.— Jan.— (Check one)

73 Magazine; 1379 East 15th St., Brooklyn 30, N. Y.

Name .... Call .... $3 yr.

Address .... $5 2 yrs.

City .... Zone ...... State .... $4 yr. DX

.... years. Start: Oct.— Nov.— Dec.— Jan.— (Check one)

73 Magazine; 1379 East 15th St., Brooklyn 30, N. Y.

Name .... Call .... $3 yr.

Address .... $5 2 yrs.

City .... Zone ...... State .... $4 yr. DX

.... years. Start: Oct.— Nov.— Dec.— Jan.— (Check one)

73 Magazine; 1379 East 15th St., Brooklyn 30, N. Y.

Subscription Department

If you like to build, you'll like 73

. . and maybe you have some friends who would appreciate getting the next dozen issues of 73. We're guaranteeing you a continued supply of good construction articles, well written and easy to understand technical articles, and the usual guff from the editor. We'll be wasting no space on monthly columns. We'll continue to run more pages of articles than any other ham magazine. Ham radio is the best hobby in the world . . . enjoy it with us. Rates: $3 per year; $5 for two years; $4 per year for DX stations outside of the U.S. & Possessions, Canada and Mexico. Note that the sub blanks are cleverly designed so you can send 'em to friends. Make note if we are to send a gift card for you.

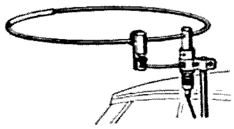
Name .... Call .... $3 yr.

Address .... $5 2 yrs.

City .... Zone ...... State .... $4 yr. DX

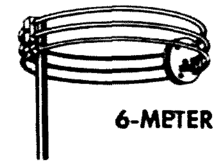
.... years. Start: Oct.— Nov.— Dec.— Jan.— (Check one)

73 Magazine; 1379 East 15th St., Brooklyn 30, N. Y.



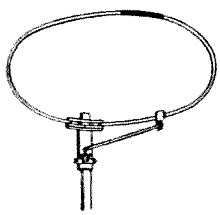
2-METER

HALO ANTENNAS



6-METER

Fixed and Mobile, for both 6 and 2 meters, by the pioneers in horizontal polarization for mobile communications.



6-METER

Hi-Par also manufactures a quality line of antennas for amateur, TV, FM and commercial services.

AT YOUR DISTRIBUTORS OR WRITE DIRECT

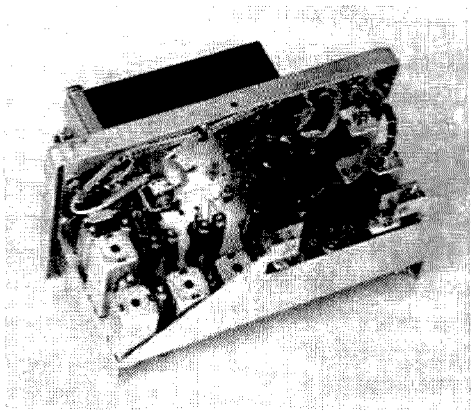
HI-PAR PRODUCTS CO. ♦ FITCHBURG, MASS.

---

the famous Bendix MRT-90 transceiver is now available!

only

$39.95



This transceiver was originally built for telemetering. Ideal for a mobile transceiver.

- **model control**
- **telemetering**
- **home station transceiver**

Complete with 19 tubes (at less than the cost of the tubes.
0.8 uv sensitivity receiver.
Double conversion, crystal controlled for extreme stability.
1 watt push-pull output transmitter, crystal controlled, phase modulated.
Built-in antenna relay, BNC connector for antenna.
6 volt dc power supply on separate chassis, plugs into transceiver.
Tuned to 138.06 mc, easily converted to 144 mc, instructions incl.
Transmitter ideal for driving 6146 for higher power.

METRO ELECTRONICS CORP. 172 Washington Street New York, N. Y.

(. . . de W2NSD from page 53)
article treatment. The object is to try to complete our articles without having to jump them to the back of the magazine. Readers get all flustered when we start an article in the middle of a page so the best solution is to use the R's D system and fill in the blanks with little spots.

How Are We Doing?

This is the question I get asked most. I assume that a lot of you would like to know. Well, we're not doing as well as I'd hoped, but we're doing better than I planned. we are just about breaking even on publishing expenses, with nothing yet left over for salaries. This, I believe, is considered to be a runaway success in the publishing field. Our circulation should be passing 20,000 with the January issue.

Wayne Green W2NSD

New Book

Repairing Transistor Radios

Now that transistor radios are turning up everywhere we find that we amateurs are frequently called upon for diagnosis and surgery. In all probability there are now one or more of these miniature frustraters in your household. Be ready when they gasp their last gasp, have a copy of Rider #270 at hand so you'll know where to find the patients' pulse. This $3.50 book covers the subject with the usual Rider thoroughness, exhaustively illustrated. John F. Rider, Publisher, 116 West 14th Street, New York 11.

Other Ham

RATHER than devote half or more of 73 to the printing of news of interest to specialized groups we believe that it is our function to do everything possible to encourage the publishers of bulletins which cater to these

HAM-SWAP. Published by Ham-Swap, Inc., 35 East Wacker Drive, Chicago I, Illinois. Editor is Ed Shuey, K9BDK. Subs are $1 per year by 3rd class mail, $3 for 1st class, $5 airmail, and $7.20 special delivery. Published twice a month. Contains classified ads entirely. This is your best bet for an inexpensive way to sell or swap some gear in a hurry. Within two weeks people are answering your ad.

FLORIDA RTTY BULLETIN. Fred W. DeMotte W4RWM, P.O. Box 6047, Daytona Beach, Florida. $3 per year including membership in Florida RTTY Society. Mostly operating news with a bit of technical info now and then. All TT men should be getting this.

SOUTHERN CALIFORNIA RTTY BULLETIN. Merrill L. Swan W6AEE, 372 West Warren Way, Arcadia, California. $2.75 per year, not including membership in Society. Operating news and some technical articles. This is the oldest TT bulletin going. All TT men should also get this one. Monthly.

73 HAM CLUB BULLETIN. Marvin Lipton VE3DQX, 311 Rosemary Road, Toronto 10, Ontario, Canada. Sent free to all editors of ham club bulletins monthly to keep them abreast of what is going on with all the other ham clubs. This is an excellent source of news for putting together your club bulletins. To subscribe to this news bulletin just send a copy of your own club bulletin to Marvin.

WESTERN RADIO AMATEUR. Don Williamson W6JRE, 10517 Haverly Street, El Monte, California. Monthly. Subs are $2 per year, $3.50 for two years, $5 for three years. Operating news of west coast activity, columns on DX, SSB, YL, and some articles. 48 pages.

Publications

nterests. These bulletins bring you the ıews you want in far greater detail and n much less time than is possible in a nonthly magazine where it usually takes ·wo months for news to get into ɔrint.

ıIDEBANDER. Official organ of the Single Sideband \mateur Radio Association, 12 Elm Street, Lynbrook, .. I., N. Y. Subs include membership to SSBARA: $3 ›er year. Monthly. Primarily operating news and chit-:hat for the SSB DX gang. Columns by W8YIN, ‹5MWU, K6EXT and occasional technical info.

'HE MONITOR. Mar-Jax Publishers, 507 West Davis ;treet, Dallas 8, Texas. $1 a year, 3 years for $2.50. Monthly. Largely operating news. Columns: YL, Club Meetings, Arkansas News, Mississippi News, Florida News, DX, Missouri News, MARS, California News, .ouisiana News, VHF News, Oklahoma News, Rio Grande Valley News, Novice News.

/HF AMATEUR. 67 Russell Avenue, Rahway, New Jersey. $3 year. Monthly. Operating news for VHF nen. Some technical info.

DX-QSL News Letter. Clif Evans, K6BX, Box 385, Bonita, California. Published quarterly. 40¢ each; An-ıual subscription $1.25 (four copies) by first class nail ($1.50 for DX stations). Lists all QSL Bureaus, nanagers for rare DX stations, etc.

DIRECTORY OF CERTIFICATES AND AWARDS. Clif Evans, K6BX, Box 385, Bonita, Cal. Complete Directory plus one year of revisions (quarterly) $3.50. Add 75¢ for 1st class mail; $1.25 for airmail; DX stations 1st class mail add $1.00. Needless to say, this is the most complete collection of data on the hundreds of certificates and awards available.

MOBILE NEWS. Published monthly by the Amateur Radio Mobile Society, 79 Murchison Rd., Leyton, E. 10, England. Joining fee and 1 year sub. is $2.50.

DX BULLETIN. Don Chesser W4KVX, RFD 1, Burlington, Kentucky. DX news in depth. Published weekly. 3rd Class mail $5 year; 1st class $6; Airmail $7.50. DX rates on request.

Instructions for using Radio Bookshop:

1) Read list of books and mark those you **must** have.
2) Check off the same numbers on the order blank.
3) Total up the bill and enclose a check, money order or cash.
4) Put the whole works in an envelope, address and mail.
5) Don't forget the stamp.
6) Or your return address.

1—ELECTRONICS & RADIO ENGINEERING—Terman. One of the most complete text books ever printed. 1078 pages. Theory, but easy on the math. $14.50

2—ELECTRICAL ENGINEERING HANDBOOK—McIlwain. Formulas, tables, circuits. A real handbook. 1618 pages. $10.00

5—ANTENNAS—Kraus (W8JK). The most complete book on antennas in print, but largely design and theory, complete with math. $11.50

10—1, LIBERTINE—Shepherd (K2ORS). Racy 35¢ book, a best-seller. Specially priced for you at . . . 50¢

20—RTTY HANDBOOK—Kretzman (W2JTP). A-Z of ham Teletype. Very popular book, low supply. $3.00

21—VHF HANDBOOK—Johnson (W6QKI). Types of VHF propagation, VHF circuitry, component limitations, antenna design and construction, test equipment. Very thorough book and one that should be in every VHF shack. $2.95

22—BEAM ANTENNA HANDBOOK—Orr (W6SAI). Basics, theory and construction of beams, transmission lines, matching devices, and test equipment. Almost all ham stations need a beam of some sort . . . here is the only source of basic info to help you decide what beam to build or buy, how to install it, how to tune it. $2.70

23 — NOVICE & TECHNICIAN HANDBOOK — Stoner (W6TNS). Sugar coated theory: receivers, transmitters, power supplies, antennas; simple construction of a complete station, converting surplus equipment. How to get a ham license, build a station and get on the air. $2.85

24—BETTER SHORT WAVE RECEPTION—Orr (W6SAI). How to buy a receiver, how to tune it, align it; building accessories; better antennas; QSL's, maps, aurora zones, CW reception, SSB reception, etc. Handbook for short wave listeners and radio amateurs. $2.85

28—TELEVISION INTERFERENCE—Rand (W1DBM). This is the authoritative book on the subject of getting TVI out of your rigs and the neighbors sets. $1.75

32—RCA RADIOTRON DESIGNERS HANDBOOK—1500 pages of design notes on every possible type of circuit. Fabulous. Every design engineer needs this one. $7.50

40—RADIO HANDBOOK, 15th EDITION—Orr (W6SAI). This is far and away the best amateur radio handbook ever printed. Over 800 pages. $7.50

45—CURTA COMPUTER. The world's smallest computer. Send for detailed information. Makes the slide rule look sick. Like a big Monroe computer only hand size. $125.00

47 — PRACTICAL ELECTRONICS — Hertzberg (W2DJJ). Almost solid with pictures. Touches lightly on many aspects of electronics: ham radio, TV, transistor radios, hi-fi, microwaves, trouble-shooting, Novice station, antennas, test equipment, etc. $2.50

48—BASIC ELECTRONICS—Covers subject completely. Written for use with RCA Institute training course. $9.25

49—ELECTRONIC COMMUNICATION—Shrader. Huge book aimed at giving all information necessary for FCC commercial and amateur licenses. $13.00

50—MICROMINIATURIZATION—This is the standard text on the subject. Don't see how a company library can be without this one. Everything is going to have to be built smaller, you know. $11.00

52—HOW TO READ SCHEMATIC DIAGRAMS—Marks. Components & diagrams; electrical, electronic, ac, dc, audio, rf, TV. Starts with individual circuits and carries through complete equipments. $3.50

53—BASIC ELECTRONIC TEST PROCEDURES—Turner. This book covers just about every possible type of electronic test equipment and explains in detail how to use it for every purpose. Testing: audio equipment, receivers, transmitters, transistors, photocels, distortion, tubes, power . . . etc. $8.00

54—HAM RADIO HANDBOOK—Hertzberg (W2DJJ). This is a lavishly illustrated book to interest people in the hobby of ham radio. Tells how to get your ticket, select a receiver and transmitter, learn the code. Pictures and info on just about every commercial piece of ham equipment. Better than a catalog. $2.50

55—TRANSISTOR CIRCUIT HANDBOOK—Simple, easy to understand explanation of transistor circuits. Dozens of interesting applications. $4.95

56 — RADIO TELEPHONE LICENSE MANUAL — Smith (W6BCX). Brand new question and answer study guide for FCC commercial licenses. $5.00

57—QUAD ANTENNAS—Orr (W6SAI). Theory, design, construction and operation of cubical quads. Build-it yourself info. Feed systems, tuning. $2.85

58—ANTENNAS FOR CITIZENS RADIO—Orr (W6SAI). General coverage, mobile and directional antennas for 27 mc. band. Build & tune 'em. $1.00

69—S-9 SIGNALS—Orr (W6SAI). A manual of practical, detailed data covering design and construction of highly efficient, inexpensive antennas for the amateur bands that you can build yourself. $1.00

70—CITIZENS RADIO CALL BOOK—Lists all calls issued until January 1960, plus lots of CB info. $3.95

71—CITIZENS RADIO CALL BOOK SUPPLEMENT—Calls from January 1960 until July 1960. $3.95

72—ABC's OF HAM RADIO—Pyle (W7OE). Designed for the Novice ham. Includes all of the information needed to qualify for the Novice License. 112 pages. $1.50

73—101 WAYS TO USE YOUR HAM TEST EQUIPMENT—Middleton. Grid-dip meters, antenna impedance meters, oscilloscopes, bridges, simple noise generators, and reflected power meters are covered. Tells how to chase trouble out of ham gear. 168 pages. $2.50

74—HANDBOOK OF ELECTRONIC TABLES & FORMULAS—Formulas & laws, constants, standards, symbols and codes. Math tables, misc. data. $2.95

75—BUILD-A-WARD QSL ALBUM—Mount your prize QSL's in this album. Room for 100 cards in each album plus labels for just about all possible operating awards. A fine way to show off your cards. $1.95

76—MODERN OSCILLOSCOPES & THEIR USES—Ruiter. Second edition. Shows what a 'scope is, what it does and how to use it for radio, TV, transmitters, etc. 346 pages. $6.50

77—BASIC ELECTRICAL MEASUREMENTS—Stout. Second edition. Covers aids to computation, measurement of resistance, galvanometers, shunts, standard cells, potentiometers, alternating current bridges, mutual inductance measurements, bridge accessories, instrument transformers, magnetic measurements . . . and lots more. $11.65

78—INTRODUCTION TO ELECTRICAL CIRCUITS—Jackson. Deals with exactly what electronics and electrical engineering technicians need to know. Complete coverage of electrical circuit theory, from beginning level. Develops concepts of current, voltage, resistance, work, and power. Shows how to expand basic concepts to solve elaborate direct and alternating current networks used in modern electrical and electronic circuitry. $11.65

79—TRANSISTOR PROJECTS—Skip the theory and start having fun. Radios: self powered, shirt pocket, regenerative, carrier-power, headphone. Instruments and accessories: sine-square wave generator, preamps for VTVM's, gain checker, shortwave calibrator, phase shifter, substitution box. Plus remote transistor ear, electronic compass, simple oscillator, lamp control, multi-impedance amplifier, electronic counter, portable power supply . . . etc. $2.90

80—SURPLUS RADIO CONVERSION MANUAL VOLUME NO. I (second edition). This book gives circuit diagrams, photos of most equipment, and rather good and complete conversion instructions for the following: BC-221, BC-342, BC-312, BC-348, BC-412, BC-645, BC-946B, SCR-274N 453A series receivers conversion to 10 meter receivers, SCR-274N 457A series transmitters (conversion to VFO), SCR-522 (BC-624 and BC-625 conversion to 2 meters), TBY to 10 and 6 meters, PE-103A, BC-1068A/1161A receiver to 2 meters, Surplus tube index, cross index of A/N tubes vs. commercial types, TV & FM channels. $2.50

81—SURPLUS RADIO CONVERSION MANUAL VOLUME NO. II. Original and conversion circuit diagrams, plus photos of most equipments and full conversion discussion of the following: BC-454/ARC-5 receivers to 10 meters, AN/APS-13 xmtr/rcvr to 420 mc, BC-457/ARC-5 xmtrs to 10 meters, Selenium rectifier power units, ARC-5 power and to include 10 meters, Coil data-simplified VHF, GO-9/TBW, BC-357, TA-12B, AN/ART-13 to ac winding charts, AVT-112A, AM-26/AIC, LM frequency meter, rotators, power chart, ARB diagram. $2.50

82—SURPLUS RADIO CONVERSION MANUAL VOLUME NO. III—Original and conversion diagrams, plus some photo of these: 701A, AN/APN-1, AN/CRC-7, AN/URC-4, CBY-29125, 50083, 50141, 52208, 52232, 52302-09, FT-ARA, BC-442, 453-455, 456-459, BC-696, 950, 1066, 1253, 241A for xtal filter, MBF (COL-43065), MD-7/ARC-5, R-9/APN-4, R23-R-28/ARC-5, RAT, RAV, RM-52 (53), Rt-19/ARC-4, SCR-274N, SCR-522, T-15/ARC-5 to T-23/ARC-5, LM, ART-13, BC-312, 342, 348, 191, 375. Schematics of APT-5, ASB-5, BC-659, 1335A, ARR-2, APA10, APT-2. $2.50

83—THE SURPLUS HANDBOOK, VOLUME I—Receivers and Transmitters. This book consists entirely of circuit diagrams of surplus equipment and photos of the gear. One of the first things you really have to have to even start considering a conversion of surplus equipment is a good circuit diagram. This book has the following: APN-1, APS-13, ARB, ARC-4, ARC-5, ARC-5 VHF, ARN-5, ARR-2, ASB-7, BC-222, -312, -314, -342, -344, -348, -603, -611, -624 (SCR-522), BC-652, -654, -659, -669, -683, -728, -745, -764, -799, -794, BC-923, -1000, -1004, -1066, -1206, -1306, -1335, BC-AR-231, CRC-7, DAK-3, GF-11, Mark II, MN-26, RAK-5, RAL-5, RAX, Super Pro, TBY, TCS, Resistor Code, Capacitor Color Code, JAN/VT tube index. $3.00

84—SURPLUS SCHEMATIC HANDBOOK—This, too, is a book of schematics . . . and just a hint of conversion strategy here and there. Contains: APA38, APN1, APR1, APR2, APS13, ARB, ARC1, ARC3, ARC4, ARC5, ARC5VHF, ARJ, ARK, ATJ, ARN7, ARR2, ART13, ASB7, AS81GR, ATK, BCAR231, AC189, BC-191, 221, 312, 342, 314, 344, 348, 375, 438, 474A, 603, 610, 611, 620, 640, 645, 652, 653, 654, 659, 683, 684, 728, 733, 745, 779, 794, 906, 969, 1000, 1004, 1023, 1206, 1335, BN, BP, C3, F3, CRC7, CRO-208, CRT3, DAE, GF-11, GO9, GRR5, 1122, 1177, 1208, JT350A, LM, MD7, MN26, PRC6, PRS3, R174, RAK, RAL, RAO, RAS, RAX, RBH, RBL, RBM, RBS, RC56, RC57, DC, DR, RDZ, SCR-274, 284, 288, 300, 506, 522, 578, 585, 593, 608, 610, 624, 628, SPR-1, SPR2, TBS99, TEW, TBY, TCK, TCS, TG34, TS34AP, TS251UP, VRC-8-9-10, VVX-1. $2.50

85—SO YOU WANT TO BE A HAM—Hertzberg (W2DJJ). Second edition. Good introduction to the hobby. Has photos and brief descriptions of almost every commercially available transmitter and receiver, plus accessories. Lavishly illustrated and readable. S2.95

R170—BASIC ELECTRONICS—Rider. Five volume set of really illustrated books. (1) Power supplies. (2) Amplifiers. (3) Oscillators. (4) Transmitters. (5) Receivers. Soft covers. $10.00

R199—GETTING STARTED IN AMATEUR RADIO—Berens (W2PIK). Fundamentals for getting Novice License. $2.40

R221—BUILDING THE AMATEUR RADIO STATION—Berens (W2PIK). Sequel to above. Everything you need to know to build your first ham station. $2.95

R235—RADIO CONTROL FOR MODEL BUILDERS—Winter. One of the best and newest books available on RC. $4.25

R245—HOW TO USE GRID-DIP OSCILLATORS—Turner (K6AI). Construction & uses, an important book. $2.50

SNS8—SOUND-N-SIGHT CODE COURSE. Three 10" LP records and instructions for Novice code, 0-8 wpm. $9.50

SNS20—SOUND-N-SIGHT CODE COURSE 20 WPM. Advanced course from 9-20 wpm, three 10" LP's. $8.95

SNS28—SOUND-N-SIGHT CODE COURSE COMPLETE. All six LP records. 0-20 wpm and full instructions. $15.95

Handy order form for people who don't mind ripping their magazines to pieces.

1	2	5	10	20	21	22	23	24	28	32	40
45	47	48	49	50	52	53	54	55	56	57	58
69	70	71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	R170	R199	R221	R235	R245	SNS8	SNS20
SNS28											

Circle the book numbers you wish to order. Please include cash, check, money order . . . or something we can deposit in the bank.

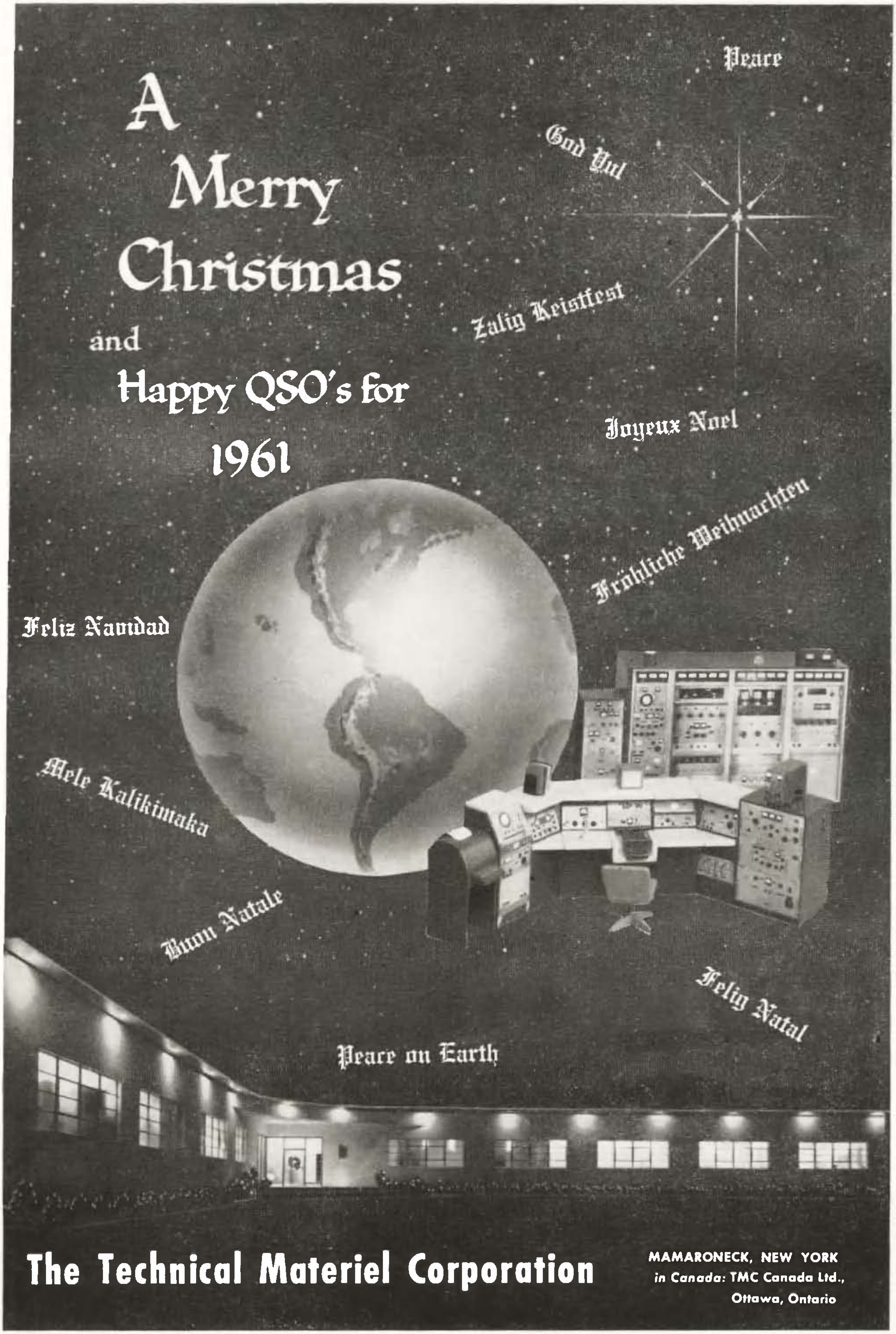
Name: ....Call: ....

Address: ....

City: ....Zone: ....State: ....

Radio Bookshop, 1379 East 15th Street, Brooklyn 30, New York

Advertisers Index


A Merry Christmas
and
Happy QSO's for
1961
Peace
God Jul
Zalig Kerstfest
Joyeux Noel
Fröhliche Weihnachten
Feliz Navidad
Mele Kalikimaka
Buon Natale
Feliz Natal
Peace on Earth
The Technical Materiel Corporation
MAMARONECK, NEW YORK
in Canada: TMC Canada Ltd.,
Ottawa, Ontario

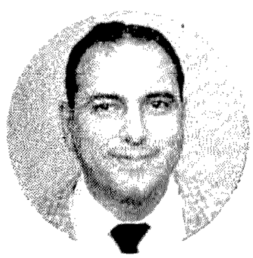
Holiday Greetings

to all our Ham Friends
the world over
from the
ALLIED Ham Shack—

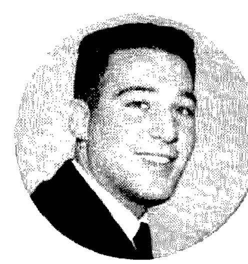
W8CZE
Jack Schneider

W9WHF
Jim Sommerville

W9BHD
Joe Huffman



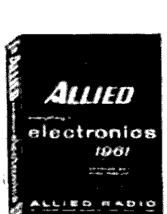
W9HLA
Joe Gizzi



W9VOB
Burt Fischel

and from the rest of the gang at Allied

W9BUD Larry Blostein
K9BYD M. Fleischman
W9CCW Rudy Ackermann
K9CDJ Joel Bolker
W9DCB Milt Fojtik
W9ECC Bob Gumm
K9EIL Don Saxon
W9EXQ Chuck Stone
K9GSB Norman Eastman
K9GXK Jack Wolfson
K9HLV R. Archambeault
K9HOB Don Wisniewski
KN9IJO Mike Heinrich
K9KEF Leon Hearn
K9KVQ Rodger Nordlund
KN9KWT Bob Oatley
K9KWY Sherwin Berger
K9MDF Jack Marcus
W9MHB Goodwin Mills
W9QBB Tasker Day
KN9RID Lloyd Mast
W9RNO Jack Matin
W9SFW Lou Dezettel
W9SIA Franklin Swan
W9THG Leo Borek
W9VHI Don Kobiljak
W9VHS Tony Marcello
W9WOV George Bercos
W9ZJU "Doc" Towler
HH2LR Louis Roumain
W9VES Phil Simmons
W9ZOA George Duffy



serving the Amateur since 1921

ALLIED RADIO

100 N. WESTERN AVE., CHICAGO 80, ILL.